THE

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THE

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HIGH-SPEED ELECTRIC TRACTION ON RAILWAYS.

AT the Engineering Conference which has lately been held in London, Mr. Jacomb-Hood, the chief engineer of the London & South-Western Railway, introduced the above subject in a short but very interesting paper, which, coming as it does from one of the principal railway men in this country, is of the greatest value as voicing the views held in railway circles; he defines the problem under consideration and states that "it must not be confounded with the problems in short distance and omnibus traffic that have alone been dealt with hitherto in this country, nor must existing practice under steam be allowed to limit the imagination as to possibilities of service by electricity. As the question develops, it becomes clear in the first place that the existing adaptations of electricity to traction are not altogether suitable for general railway business, including economical high speed services; and, further, it is practically certain that the substitution of electricity for steam as a vehicle of power will of itself produce a change of general ideas and general methods."

Although, as Mr. Jacomb-Hood very correctly says, there have been no long-distance electric lines constructed as yet in this country, there are some very fine examples of lines from 60 to 100 miles in length being operated at the present day in the United States of America, on which speeds up to 60 miles an hour are frequently reached. At the same time, these lines are more or less separate undertakings, and are not running in conjunction with the old-established steam railroad systems.

There can be no doubt that there are serious difficulties in the path of railway companies. There are many portions of suburban and other lines upon which the traffic is very dense and the stations very close together, constituting a state of affairs with which electric traction is pre-eminently suited to deal; and if the lines had to be built at the present day, there could be no doubt that electric traction would mean increased receipts and decreased working expenses compared with steam, and would give an infinitely better service at the same time. According to Mr. Jacomb-Hood, the reason why the railway companies do not make the necessary transformation is almost entirely a financial one, and we quite agree with him that it is this which is at the root of their hesitation. The difficulty is sufficiently real to cause the railway companies to shirk the responsibility of decisive action, unless competing lines force their hands, as will undoubtedly be the case in the near future.

We are glad to see it stated by such an authority on railway matters, that "it may be granted that conversion, in the case of services where electricity can with certainty compete economically with steam, will come, and that any new railways, built to connect large centres of

traffic with a high speed service, will, without doubt, be equipped electrically.

Mr. Jacomb-Hood divides his subject into three sections, viz., generation, consumption, and transmission. In the first section, in considering the power station, he entirely ignores the steam turbine. This is the more surprising in view of the fact that the Metropolitan District and the Metropolitan Railways are installing 5,000 KW. turbo-generators in the power stations which are now being erected at Neasden and at Chelsea Creek, and that the Yorkshire Power Co. are doing the same. Furthermore, turbo-generators are also installed in the power station which will supply current for the experimental loop line which the N. E. Ry. Co. is constructing on Tyneside, and we certainly cannot agree with the statement that "it can be foreseen with some confidence that moderate speed engines directly coupled to alternators generating in single or multi-phase form at tensions as high as circumstances allow, will be used."

In considering the second division of his paper, we quite agree with Mr. Jacomb-Hood that for long-distance lines, and particularly for high speed long-distance lines, the general course of events points towards the use, in some form or other, of alternating current motors, as this will considerably decrease both the cost of installation and the complication of operation.

In treating of the transmission and distribution, Mr. Jacomb-Hood, as a railway man, is naturally faced by what is certainly a difficult, although not an insurmountable, problem, viz., the question of the difficulties of distribution with the large amounts of power that would be necessary in railway work. The question of the relative advantages and disadvantages of overhead wire and third rail conductors, was fully discussed in the famous arbitration which took place two years ago between the Metropolitan and Metropolitan District Railways, in deciding as to the system of traction which should be adopted on their lines. Without going into this question again now, we think that it is quite possible to lay out a third-rail system which would prove perfectly satisfactory; if considered advisable some system might be employed in which the rail is dead, with the exception of that portion over which the train is passing.

Mr. Jacomb-Hood does not, we think, appreciate the fact that with high voltages on the working conductor, such as are used on some of the overhead lines on the Continent, the actual current collected is not at all large, which greatly reduces the difficulty of collecting the same from the conductor. Such pressures, of course, can only be used with overhead working conductors.

As for Mr. Jacomb-Hood's emphatic statement regarding accumulator traction, undoubtedly, on the face of it, this method is most attractive, but it must be admitted that up to the present date there exists no accumulator which has ever given satisfactory results for this class of work, whatever may be forthcoming in the future; in any case, we agree with the author that pure accumulator systems have no immediate promise for heavy general railway work, and in view of the repeated failures which have been experienced with accumulator traction, whether by itself or combined with the overhead trolley, it would be exceedingly inadvisable at this time for a railway company to launch forth into any extensive experiment in this direction.

The L.C.C. Amateurs in Conclave.

WHEN one contemplates the proceedings of some of our "admirable municipal institutions," one is often at a loss to decide whether they are more laughable or more exasperating. In the case of the debate of the L.C.C. which was reported in our last issue, however, there is no room for doubt. Misrepresentation, inaccuracy, and surmise such as are found therein can only excite the indignation of professional readers. Yet there are some members of the Council who know, and who endeavour to enlighten their colleagues. For example, the remarks of Mr. Sydney Low were temperate, thoughtful and to the point; the only propositions to which we can take exception are his suggestions that difficulties may be experienced with the conduit due to flooding and in cleaning, which we think are unimportant. At the present rate of progress it will certainly be several years before even 100 miles of track are electrically equipped, and as Mr. Low suggests, 15 or 20 years must elapse ere the conduit system is extended throughout London. Who knows what may happen by then? Certainly the last word has not been uttered in electric traction, and the conduit, in its present shape, has barely existed for 10 years.

Mr. Straus pointed out that the Borough Councils would not accept the overhead trolley system, and adduced that of Stepney as an instance; the borough councillors naturally ask why they should have overhead wires, when other parts of London have the conduit? Thus do the misdeeds of the L.C.C. recoil upon its own head, for had it not belauded the conduit system, and abused the trolley system *ad nauseam*, it would not have had to explain to the subordinate authorities that what is good for aristocratic Lambeth won't do at all for democratic Stepney, and so on. Such invidious distinctions are odious to the self-respecting ratepayers of the East-end. "The only way to transform the tramways, was to adopt the conduit system, and ask ratepayers to bear the expense, *which would not be regretted afterwards!*" Well—we trust not . . . . but we have our misgivings.

Mr. J. A. Baker perceived that Mr. Low was "biassed in favour of one system." This, from Mr. Baker, is a gem of the purest water. Surely the speaker intended it as a compliment to Mr. Low; a touching acknowledgment of the flattery of imitation, though we cannot regard it as justified. Mr. Baker then said that "the trolley method was being replaced in many cities by the more sightly, safer, and, in the long run, more economical conduit system." We should be glad to learn the names of the "many cities," and exactly how the conduit is more economical than the trolley—a thing which has never been revealed even by the most ardent advocates of the conduit. Is it more economical in sinking fund and interest on capital? Is there any saving due to its use which can be named in comparison with the extra £700 per annum per mile of single track entailed by its adoption?

"It was well known that, when once laid down, there was no disturbance of the conduits themselves for 30 or 40 years, whereas the overhead work on the trolley system had to be replaced every three or four years." We cannot adequately characterise these statements and be polite. The oldest conduit system working—that at Buda-Pesth—was started in 1889, 14 years ago. Whence comes Mr. Baker's authority for "30 or 40 years?" As for the replacement of the trolley construction every three or four years, how can even a County Councillor utter, or believe, such nonsense? Our readers will know how to deal with it. Mr. Baker knows perfectly well that the question of interference with Greenwich Observatory had nothing whatever to do with the adoption of the conduit on the South London lines, and will only affect a small proportion of the tramways projected. He claimed that traffic on the conduit lines was not stopped by the recent floods, though "other systems and the under-

ground railways were blocked and flooded." What other systems? and what has the underground railway to do with it? Moreover, even the conduit will be shut down in flood-time, where it passes through a depression. Mr. Baker arbitrarily reduced the excess cost of the conduit system to £4,000, or £4,500 per mile of track, and restated the imaginary economy of the system, to the adoption of which he appeared to attribute the fact that (during a few weeks' working) the cars had earned 15d. per mile instead of 12d. as estimated; but the trolley car would have earned the same, and would have been doing so six months sooner.

Mr. Waterlow pointed out the difficulties that the trolley system would meet with in negotiating the railway bridges in the north of London. Seeing that the conduit cars in South London have already accounted for some hats and nearly killed one passenger in passing under bridges, we fail to see the force of this argument. The trolley car, in fact, can go under any bridge that a conduit car can pass through with equal safety. *Apropos* of the South London bridges, seeing that a sudden and untidy death awaits the passenger who stands up to them, and remembering the attachment of the L.C.C. to æsthetic appearance, we would suggest that a sloping roof be fitted to each bridge, making an angle of, say, 30° with the horizontal, so that the incautious passenger, instead of being brained or knocked off the end of the car, will be simply bonneted, and persuaded to sit down—rather quickly, perhaps, but, at any rate, with a fighting chance of survival. For the rest, Mr. Waterlow found quite a number of advantages in favour of the trolley system, which had apparently been forced upon his attention by the fact that the North Metropolitan Tramways Co. had manifested a disposition to fight shy of the conduit.

Mr. J. W. Benn invoked the authority of the Local Government Board, and capped the discussion with the remark that what was good enough for a syndicate was good enough for the Council. Ye gods! That we should have lived to see such humility on the part of the chairman of the Highways Committee! Mr. Benn was referring to the conduit system; but that does not affect the force of his remark. Probably we shall see, by-and-by, that the trolley, which is good enough for the North Metropolitan, will be good enough for the L.C.C.—perforce.

Pollák-Virág Rapid Telegraph.—We have received from Herr A. Pollák a pamphlet relating to the development of this most interesting system of high-speed telegraphy, since the International Conference at Paris in 1900. The apparatus have now been put into practical shape, and are in successful use between Berlin and Frankfort, a distance of about 370 miles. The chief difficulties which have been overcome, were the construction of automatic developing apparatus and a perforating machine, both of which raised entirely new problems. The former apparatus, now perfected, enables development to be completed in from 5 to 6 seconds, and fixing in 6 to 7 seconds, while the sensitive paper leaves the apparatus almost dry and ready for delivery. The perforator is operated like a type-writing machine, needing a minimum of practice, and is capable of perforating five or six letters per second. The system was applied with the improved apparatus over the line between Pozsony and Buda-Pesth, 133 miles long, and worked satisfactorily from October 24th to December 18th, 1902, reaching when required a speed of 45,000 words per hour with two line wires. On the strength of this performance the Hungarian Academy of Sciences awarded the inventors the Wahrmann prize; the Hungarian Postal Department also reported most favourably on the practical working of the system, but could not adopt it because the telegraph department could not find enough work for it! Later, Herr Pollák (unfortunately Herr Virág died in 1901, at the early age of 31) demonstrated the apparatus at Berlin before the German Emperor, and experiments were carried out by the Imperial Post and Telegraph Department on lines between Berlin and Königsberg, 370 and 440 miles in length, with satisfactory results, in consequence of which the system is now in practical use between Berlin and Frankfort by the Imperial Post Office.

It may be noted that iron wire lines are not suitable for use on the Pollák-Virág system, owing to electro-magnetic inertia difficulties, but bronze lines are perfectly satisfactory. The telegrams are reproduced by the apparatus, not on ribbons, but in column form on paper 2¾ in. wide, ready for delivery without re-writing or pasting on a form.

PROTECTION OR FAIR TRADE.

[COMMUNICATED.]

There is an Italian proverb somewhat to the effect that a man always thinks another man's wife prettier than his own. The English of this is concisely expressed in the leading article of the Electrical Review, June 5th, thus:—"We English people are too prone to see our disadvantages, and not sufficiently ready to recognise the disadvantages of other people." We magnify every little disadvantage of Free Trade, and minimise the greater evils of Protection.

In the present controversy, Protectionist writers claim to have on their side a monopoly of intelligent argument, and those who venture to think differently are stigmatised as "Cobdenites, political adventurers, political economy theorists, and parasites on the community." This is not argument; it is not even courtesy. It is the last resort of disputants when a case is going against them—viz., abuse of the opponent—and is a well-known trick of advocates in legal causes.

Without wishing to be in the least discourteous, it certainly strikes one in reading the arguments of Protectionists that they are all based primarily on selfishness, each man speaking for himself or the special industry in which he is directly interested. "Protect *me* against the foreigner," is the motto. Many of the arguments advanced are so extreme as to damage the cause espoused, rather than assist it.

Take, for instance, a few arguments of the author of a book which—in the author's opinion, at any rate—has converted Mr. Chamberlain from a Free Trader into a Protectionist. Let us see to what they lead us.

"To-day," says Mr. Byng, "we are far behind other countries, and we are even compelled to obtain abroad the equipment of our biggest electrical undertakings, such as central stations and tramways." Granting, for the moment, that this may be the case, what is the alternative?

When the boom in electrical tramways and power distribution came, English manufacturers were not in a position to supply the necessary machinery. This is generally admitted. It is also well known that there was no slackness in engineering works, but that for ordinary standard machinery, makers quoted deliveries of from 9 to 12 months. If Mr. Byng could have had his way he would have prevented the purchase of foreign machinery, which, quite apart from the possible saving in cost, would have put back for a few years the development of this branch of the electrical industry in England. And this, notwithstanding his own argument that "we are far behind other countries in electrical progress."

But the purchase of foreign machinery is not confined to tramway work. Take ordinary motor equipments, for example. A few days ago quotations were asked for some motors, say, for a printing works. The quotations varied by 70-per cent., a foreign one being lowest. Would Protection prevent this? That is, is it proposed to put such an import duty on foreign machinery as would bring the price of the imported article above the lowest priced home-made machinery?

Now the Protectionists' argument, as put forward by Mr. H. W. Wilson in the *Electrical Times*, July 9th, is that if the foreign motors be purchased, the amount paid "is lost to the labour market, the profit on it is lost to the home capitalist, the shopkeepers lose the workmen's wages which would have gone into their shops on pay nights, and the country's exchequer loses a percentage that would have been otherwise paid as taxes; but apart from these all-round financial losses, the country is so much the poorer in not having found the work for able-bodied workmen, who, instead of having been at work earning their own living, have possibly been supported out of the rates, or have had to leave their own country for ever and seek work in the foreign factories to which the order may be sent." It is a gloomy picture indeed, and the mere recital of the above quotation literally takes one's breath away. Now then, "Reply to that, you Free Traders, you political economy theorists, you parasites, and let 'em all come," says Mr. Wilson. It is enough to make a mere parasite hide himself, lay low, and say nuffin. But is there *no* reply? Surely! One cannot hope to rise to such heights of impassioned eloquence as is to be found in the lines quoted above, but the plain unvarnished reply is, that by paying, say, £100 instead of £170 for his motors, the printer is £70 better

off. His standing charges are less, he can afford to pay his men more wages, or, by cheapening his prices for printing, can find more work for his men, probably obtain foreign printing orders, employ a few of those men now obtaining parish relief; the shopkeepers will draw more on the men's pay day, and, instead of having to emigrate to find employment, the workmen may find that a German or a Frenchman has been glad to come over here for a job in their works. And this is only half the story. If the foreign motors are excluded, probably no motors would be bought at all; the printer could not afford it. Then he could not compete with the more up-to-date works, he would lose orders, which might even go to Germany, orders which would soon amount to more than the value of the motors he might have bought.

Turning now to the cost of production argument, we are reminded of the old lady shopkeeper, who lost money on every article she sold, and it was only by selling such enormous quantities that she could make ends meet.

"It is not true," says Mr. Byng, in effect, "that the cost of a manufactured article depends upon (1) cost of material, (2) cost of labour, and (3) expenses. It may have done so 60 years ago, but to-day it depends on *quantity*. This factor overshadows the others." It surely cannot be seriously argued that, without reducing the cost of wages, labour and standing charges per piece, or per machine, that the total cost of manufacture will be reduced by turning them out in greater quantities! The suggestion—for it certainly is not argument—is obviously absurd. One knows that by manufacturing standard parts in large quantities, the labour costs and the expenses—meaning, I take it, standing charges—on each part or machine may be very considerably reduced, and it is in this way, and only in this way, that "quantity" pays.

Then we are told that the "cost of production is higher in a Free Trade country than in a protected country," although wages and salaries are higher in the latter. (The presence of such large numbers of foreigners in this country, not counting English-speaking ones, can no doubt be explained by the laudable desire to learn our beautiful language.)

"So convinced am I," says Mr. Byng, "of higher wages for the working man in an era of protection, that I am prepared to give an undertaking to pay higher wages *as soon as this country protects me against the foreigner*" (the writer's italics). "Buy half a pound of our 2s. tea and we will make you a present of a tea service," say the tea dealers. Well, there may be people in this country so simple as to believe in the free-gift idea, and many workmen may be misled by specious sophism of this kind, which promises higher wages without apparently an equivalent increase in their work or output—*sancta simplicitas*.

Accepting, however, the rise in wages, it is pertinent to ask who pays it; does the manufacturer? Certainly not, the buyer pays, *as usual*. Under an era of protection prices would rise at once, and the buyer would pay not only the extra wages Mr. Byng is so anxious to give, but the extra cost of raw material imported, and the manufacturer's extra profit. And how much would the extra amount to? One writer asks: "Would the working classes rather have to pay 4d. for their loaf with 3d. in their pockets to do it, or 5d. for their loaf with 6d. with which to pay for it?" Buying a 4d. loaf for 3d. does not leave much for the "small fishes," but will any Protectionist tell us what it means in £ s. d. to *double* the wages of the working classes, and where the purchaser comes in, who pays for all this in addition to the enhanced prices all round?

In view of the higher prices said to be paid for labour in protected countries, how comes it that the foreigner can pay freight and packing charges, and undersell the home manufacturer? It is the quantity again! "The foreigner has enterprise, he builds large works because he has two markets, his own and ours, *he makes larger quantities than we do*, and as price is regulated by quantity, he can make more cheaply than we can, *besides having better machinery* to do it with." The last italics are the writer's. The foreigner has better machinery, says Mr. Byng, which helps him to manufacture more cheaply than we, and yet Mr. Byng wants to prevent us getting that machinery. But this is not the whole of the argument. Although the foreign manufacturer produces more cheaply, his countrymen get no advantage; in fact, they pay more than they would if England were *not* a free country, for, to quote further from Mr. Byng, the foreigner, "finding competition in this country, and fearing only home competition in his own, he dumps his *surplus* output into England at a ridiculously low price, making his own countrymen pay any possible loss."

Could the foreigner have a stronger argument in favour of Free Trade for his own country, or the Briton a better one against the introduction of a protective system? If Protection means that our home manufacturers would compete in foreign countries at less than cost price, saddling the English customers with the loss, then the less we have of Protection the better.

But, again, assuming Mr. Byng's reasoning to be correct, it leaves much to be explained.

If protected countries offer such great advantages and facilities for cheap manufacture, it is more than strange that foreigners should come over to this Free Trade country to establish manufacturing works, and so deprive themselves of the benefits of free competition in their own countries.

The British Westinghouse, British Thomson-Houston and other big concerns, which have found it advantageous to manufacture on the spot rather than send machinery from abroad, have only followed the example set them years ago by Mr. Byng himself, who, having, under a Free Trade *régime*, come over and established one of the biggest electrical manufacturing concerns in the kingdom, now complains—not, we hope, holding the mirror up to nature—that Free Trade is ruining the country. Truly, an unfortunate admission.

"Free Trade," we are told, "stifles invention and new industries, drives skill and originality to other shores, and leaves us intellectually, physically, socially and morally lower than our neighbours, because it deprives us of the ambition to develop our own estate."

Intellectually, physically, morally lower than our neighbours!!! It is impossible to discuss seriously such extravagant, not to say insulting assertions, which are absolutely unsupported by argument.

If Protection can be proved to be right in principle, and to offer the advantages claimed for it by its adherents, by all means let us have it, and have it in full measure; "no half and half affair, but a right down regular thing."

Let us build a ring fence around every town, and tax every article coming through the gates. The French have their *octrois*, why not we?

But, everyone agrees that *Universal* Free Trade is the ideal condition; that every locality should produce that for which it is *naturally* adapted is correct in principle.

If we cannot get this, let us aim at obtaining the nearest approach to it, which is not necessarily wholesale Protection.

Hitherto we have been greatly handicapped by allowing other nations to believe that, under all conceivable conditions, we are wedded to Free Trade; that it is an irrevocable article of faith with us. It is easy, though very unsportsmanlike, to fight a man whose hands are tied behind him, and we are in the position of that man, unable to retaliate. It is well known that foreign countries have taken every advantage of this position to impose the most harrassing and damaging tariffs on some of our staple industries, some of which have been irretrievably ruined in consequence.

Once remove the shackles, and place ourselves in the position of being able to retaliate—to give blow for blow, having already offered "the other cheek" to the smiter, which he has not hesitated to strike, and the necessity for retaliation will soon be largely removed. Let it be clearly understood among foreign nations that with what measure they mete to this country it shall be measured to them again, and we shall very soon be assured of fair measure and fair trade.

LORD AVEBURY AND THE LONDON COUNTY COUNCIL.

The financial result of the tramway business of the L.C.C. is a hard nut to crack, and Lord Avebury on the one hand, and Mr. Benn on the other, form opposite opinions as to the value of the kernel! To follow out the symbol, we are disposed to say that so far as the ratepayers are concerned, the whole question is in a nutshell.

Apart from the great principle involved in the controversy as to the wisdom of municipal trading—especially in electrical matters—the financial result should be plain enough for the proverbial "meanest capacity."

Lord Avebury says it has not paid the L.C.C. so well in working the South London tramways themselves as in leasing the North London tramways to a company, and Mr. Benn, taking up the case for his Council, really admits it so far as the cash result is concerned.

The Highways Committee of the London County Council, of which Mr. Benn is the chairman, have recently issued their accounts of tramway receipts and expenditure for the year ending March 31st, 1903. From these accounts it appears that the surplus revenue on the northern system in respect of the year 1902-3 is £37,794 0s. 4d., which is all profit, whereas there is a deficiency on the southern system of £2,250 16s. 10d.

This statement conclusively proves the case put forward by Lord Avebury.

The two systems (North and South London) are very similar as to extent, and if the County Council had been wise enough to lease the southern lines, as they did those of the north, to an expert company, the ratepayers would have derived about double the profit realised. Mr. Beachcroft pointed out in a recent discussion that the arrangement with the North Metropolitan Tramway Co. had been a good thing, because it had brought in £40,000 a year, *which was the only profit to the Council from the tramways.*

Lord Avebury raises two points, viz., the principle of municipal trading as opposed to private enterprise, and the financial results.

The risks attending the business are not those which should be undertaken by the representatives of ratepayers, and there is a good deal in the contention of Mr. Sidney Low, that public money ought not to be sunk in costly experiments, such as the adoption of the conduit, upon the merits of which even their own technical advisers are not unanimous.

Mr. Benn explains that the diminishing figures in the south are due to the process of reconstruction for electric traction, high price of forage, &c., but if the business had been in the hands of a private company, these causes of interruption would have been the same, but the profit to the Council would not have been affected.

The Council, acting prudently in the interests of the ratepayers, should have preferred the bird in hand to two in the bush. Mr. Benn minimises the net result of the proposed lease of the southern tramways by contending that, after deducting interest and sinking fund, the average profit would only have amounted to about £14,250. If this were so, it would have been obviously better for the ratepayers to receive a net profit of £14,250 than provide for the admitted deficiency of £2,250 16s. 10d.

The speculation in the conduit system is an instance of fools rushing in where angels fear to tread. It may be an extreme view, but as Mr. Sidney Low pointed out to the Council as a reason for objecting to the increased cost and doubtful working of the conduit system, "Before an elaborate conduit system could be adopted, 10 or 20 years must elapse, and they had no guarantee that the system would not then be as obsolete as horse traction," adding that they ought to sink as little capital in rails and wires as possible, for accumulator cars, among other developments, might render them unnecessary, and it would be better to scrap a tramway system costing £7,000 than £14,000 per mile.

Lord Avebury pointed out, with respect to the capital expenditure in the north and south, that it was practically the same, viz., £850,000 on the north and £896,000 on the south, but the mileage on the north is about 18 miles greater.

Mr. Benn does not appear to dispute the question of capital outlay, but contends that the latter system is only half that of the north.

If this were so, it would look as if the cost in the south under the Council had been considerably larger than in the north under the company. The explanation that in the south "the rolling stock, horses, &c., had to be included in the purchase, as the Council worked the lines" is not clear, as similar results would exist in the north, where the company worked the lines.

The falling off in earnings during reconstruction, and increased cost of working due to high price of forage, is applicable to both Council and company alike, and is no explanation.

That the financial results may be unfavourably affected by the conditions under which the business is worked may be readily understood. If the employés are paid better wages for less work, and halfpenny fares established, which do not pay—it is not an argument which will commend itself to business men—although it may accord with the views of those who aim at the transfer of all trading business to labour-governed municipalities.

LEGAL.

Patent Exploitation, Ltd., v. The American Electrical Novelty and Manufacturing Co., Ltd.

(*Continued from page* 46.)

On Friday, June 12th, Mr. Carl Schall, examined by Mr. Moulton, said he was an electrician, of 55, Wigmore Street, London, and had been in business for sixteen years. He used dry cells previously to 1890. The Gassner cells were in the market, and there were what were called Dr. Stein's cells, and Hartmann and Braun dry cells. There might have been more, but he was only acquainted with those three. Gassner was well known at the time. It was a cylindrical battery with zinc outside. They were good cells. He used them for induction coils, and he knew that they had lasted at least for about eighteen months. Hartmann and Braun were square-shaped. The containing vessel was zinc, and the central pole carbon. He had cut one of them open. Near the zinc was a white paste, which evidently was plaster of paris, with chloride of ammonium inside, and near the carbon was some brownish-looking material, paste or powder, which he took to be manganese; but he had learned since that it was permanganate of potash and some materials likely to form manganese. Inside the second paste was carbon. That was a good cell. After 1890 he used a few thousands of E.C.C. cells, and the first ones burst open without being used. He returned them and they were replaced free of charge. Afterwards they were improved so that they did not burst any more; but they were used up and were useless after about nine or ten months. This was not sufficient for his purpose. He used the Hellesen cells and the Obach cells afterwards. They lasted at least twice, if not three times as long as the E.C.C. cells. The first few hundreds of the E.C.C. which he bought all burst. He used the Hellesen cell to-day. In 1888 he sold about a thousand of the Stein cells. The containing vessel was glass, and inside was a cylinder of the agglomerate type.

Cross-examined by Mr. Astbury, Witness said the General Electric Co. took the burst cells back and supplied him with new ones. After 1891 and 1892 they improved a little, and he used them for two years more; but as they did not last a reasonable time he gave them up. The cells he sent back were square, and were about 2½ in. to 3 in. high and 1½ in. wide.

The Obach were made by Siemens, and the Hellesen he bought were also made by Siemens. He had cut open one of the Hellesen cells.

Outside was cardboard, inside was some sawdust, and then a round cylinder of zinc, some white metal, and round the carbon was a mixture, which he took again to be manganese, and inside the carbon pole. He used the cells for batteries for medical purposes, and for batteries for lighting small lamps for surgical purposes. They would be in action for a short period at a time and then stop again.

Of course a large cell will last longer than a smaller one?—The large E.C.C. cells will be exhausted or used up, whether they are used or not, after about 10 months.

In the case of any E.C.C. cell that expired after about 10 months, did you ever examine it to see whether the zinc was good or bad?—The zinc was extremely thin, but I have not examined anything else.

You know, do you not, as an electrician, that if bad zinc is used the cell very soon comes to grief?—Yes.

Mr. Arthur Albert Cousins, examined by Mr. Moulton, said he was in the employ of the American Electrical Novelty Co, and for the last 12 months he had been making cells.

What materials do you use?—We use a zinc cylindrical cup. Then we have a round cardboard dipped in paraffin wax, and then a sheet of blotting paper packed round the inside of the cylindrical cells or cups. Then we have another cardboard on top of the one we use at the bottom, not paraffined. We pour the solution into the cylinder and then drain it out. Then I take a carbon rod and a stamping iron and put the carbon in the cup. I fill it up with powder a little way, and take a heavy mallet and hit it down as hard as I can.

Have you ever had any instructions to alter your method of manufacture at all?—No.

Mr. Francis Arthur Darton, examined by Mr. Moulton, said he carried on business as an electrical engineer at 143, St. John Street. He had used Gassner's before 1890. That was a very good cell.

At what price was the E.C.C. cell put on the market?—At a considerably lower price than the Gassner cell, if I remember right. They made some special terms in order to get us to sell them amongst our trade customers.

What terms did they make to you?—I think it was 50 per cent. off—half catalogue price.

Did you have trouble with those?—Yes. We had some trouble. They were not altogether satisfactory, but, as a rule, they changed them.

Into whose hands did they pass afterwards?—Into Binswanger's, trading as the General Electric. They went, as I considered, rather behind our back, and made arrangements with the Electrical Construction Co. that they should have the sole sale of the battery, and we, being wholesale, and having sent out our list, felt rather sore on the matter.

Afterwards, did you get them from the General Electric Co.?—By special arrangement, through the Electrical Construction Co., the General Electric gave us a special quotation, at the same rates, as far as my recollection carries me; we were to have 1,000 of them as the first order.

What was your experience with those cells at that time?—Well, we were constantly sending them back.

Why?—I can say, at any rate, quite three-quarters of them. You can understand my position as a wholesale man getting a small profit on them, sending them out to customers, and receiving them almost immediately by return, saying they were no use. We lost considerably in the matter.

Did they take them back and change them?—Yes; but we had a good deal of trouble. We had one very large consignment which we were obliged to tell them was utterly useless. As they stood in stock there were pools of water formed; the batteries burst, and we could get no action out of them.

Cross-examined by Mr. Astbury: Do you know anything about a Mr. Darton, who is the defendant in an action brought by the plaintiffs?—I am a defendant.

You are being sued at the present time by the Patent Exploitation Co.?—Yes. I was written without even a notice to that effect.

You are very sore about it?—No; I am not sore about it.

At all events, you are now being sued by the plaintiff company for infringement?—Yes.

Have you got any documents showing that 50 per cent. discount was allowed by either Mr. Barrett or the General Electric Co.?—I have some invoices here. Here is one. I think that will convince you. A credit note from the General Electric Co. for 16$\frac{1}{12}$ dozen No. 3 E.C.C. dry cells, and another one of 4 dozen No. 4 and 7 doz No. 2; there is 45 per cent. underneath that Then 4$\frac{1}{2}$ dozen No. 2 E.C.C. dry cells, and $\frac{1}{4}$ dozen No. 3, and 45 per cent. off, and 50 per cent. off that.

This note only deals with cells returned to them by you?—On account of their utter incapacity.

Mr. Justice Buckley: There are two parcels here. This document, as I understand it, shows this—that as to the first parcel he is given credit for the whole sum which he paid for them, and that that sum was the list price less 45 per cent. That is the first parcel. Then there is the second parcel, and as regards that the document shows that he paid for them the list price less 45 per cent., but for some reason they do not credit him with the whole of that, but only half.

Mr. Justice Buckley: You said you returned three-quarters of the cells you ordered. Have you got anything in writing to show that?—What I said was, that quite three-quarters of them went wrong. I am sure we sent three-fourths of them back eventually. I have nothing in writing to show it.

Mr. Astbury: Had you an arrangement with the General Electric Co. that, as soon as a cell was worked out, they would make you an allowance on its return?—I believe there was some proposal made afterwards, but I do not believe we ever availed ourselves of it, because we never had any in work, and we never certainly took any back, as far as I am aware of, from our customers and allowed them half. We certainly should not have returned them unless we did.

What was it that happened to the batteries that made you return them?—They went wrong in stock. The great portion of them had no voltage. Others burst.

Did you ever examine them to see whether they burst at any other place than the soldering joint?—Yes. I had many of them in my hands. It did not strike me whether they went at the soldering or the other part, but I think the majority of them were not at the soldering.

You do not know that they burst at a place other than the soldering?—Some of them may have burst at the soldering, but the great majority of them, as far as I recollect, did not.

Did you examine a single burst cell for the purpose of ascertaining whether it was burst on the soldering line or somewhere else?—Certainly not; it did not trouble me. They did not act.

Did you make any examination to see whether it was pitting owing to bad zinc?—I left that almost entirely to my employés. I do not handle my stuff, as a rule.

Mr. Frederick Walker, examined by Mr. Moulton, said that prior to 1890 he was a maker of dry batteries. He sold about 5,000.

Will you describe those batteries?

Mr. Astbury: I must object. This can be relevant to nothing but a user, and there is no suggestion of user by this gentleman. This is the patentee of this provisional specification.

Mr. Justice Buckley thought the evidence was admissible.

Further questioned by Mr. Moulton, Witness said the containing vessel of the cells he put on the market was zinc, and the inner pole was an agglomerate of pulverised carbon and binoxide of manganese and sugar to combine the whole—pressed, not baked.

Mr. Astbury: I submit that this gentleman, speaking as an individual maker, and not as a member of the public, knowing general knowledge, cannot speak to the making of a battery of which they have put in a specification, and which they have not pleaded a prior user.

Mr. Justice Buckley: I think that that objection is not well founded. What is pleaded is, that the invention had been used "by the general common use" of certain things which are named. I think that under that plea the defendants can prove a particular use, which is part of the materials by which they are going to show a general use.

Mr. Moulton, to Witness: Will you describe what was the layer next to the carbon pole in the saleable battery?—It was made of peroxide of manganese in a tolerably broad granular state mixed with carbon in a similar state; in fact, passed through a hair sieve, and then with sugar syrup, and then pressed with an ordinary hand press.

You say you passed it through a hair sieve—the original stuff before mixing with the syrup I should say?—I should say it was about $\frac{1}{16}$ in. mesh.

How did you make the outside layer of the 5,000 batteries you sold?—I made it with plaster of paris and pea flour preferably and sal-ammoniac.

Cross-examined by Mr. Astbury, Witness said he made the batteries in his workshop and did not disclose his manufacture to anybody except his apprentice. The only publication he ever made was the provisional specification of 1883. He did not go on with it as he was engaged in other matters Originally he made an agglomerate pole. The single agglomerate mass would not work well because it became disintegrated at the bottom.

You found it was bad with the central carbon pole?—I found it was not quite a mercantile thing. It acted all right electrically. Further cross-examined, he said that when he made the alteration he did not tell anybody what he did, but they could come into the workshop and see if they chose. He made no secret of it.

Mr. Edward James Tumber, examined by Mr. Moulton, said that before the year 1890 he was a purchaser of dry cells. He purchased some from Mr. Arthur Ford-Lloyd in September, 1889. After that he ceased to purchase from him until about July or August, 1890. He sold his business to the Electric Stores, of which company he was manager. An action was brought against him by the plaintiffs this year, and he brought an action against them for threats. The action for threats was compromised. His partner, Mr. Elliot, had the negotiating of it.

Mr. Moulton: I call for those terms of compromise.

Mr. Astbury: I produce them under protest. I say they are not relevant. It is a private document between my company and another firm.

Mr. Justice Buckley: If there is anything in that which will hurt you through trade rivals seeing it, that is another matter?

Mr. Astbury: There is a great deal in this that might injure me and other people. This is an action brought against the gentleman and his partner, the witness who is now in the box, and in that action they at first alleged there was a prior user. The action was afterwards compromised, and they entered into certain terms with me. One of the terms was that they should pay me a royalty. There are other terms in this document which I do not think it is fair or right I should be made to show. I have a number of actions pending against other people. These are the terms upon which we shall carry on the trade, the amounts of the discounts and royalties.

Mr. Moulton said the point he wanted to get at was that this compromise was a compromise with people who they knew could prove a prior user.

Mr. Justice Buckley said he did not see anything in the document which suggested what Mr. Moulton represented.

Mr. Moulton: Am I not entitled to know the amount of the royalty, my Lord?

Mr. Justice Buckley: No.

Cross-examined by Mr. Astbury, Witness said Mr. Thompson had called upon his firm in 1893. At that date Mr. Thompson was threatening an action with regard to the E.S. battery that they were then making.

And did you tell Mr. Thompson that you had purchased batteries before the date of his patent?—I did.

Further questioned, Witness said he was quite clear that the battery which he showed Mr. Thompson, and which was taken away, was one of the batteries purchased from Mr. Ford-Lloyd before February, 1890. The E.S. battery was first put on the market in 1890.

On June 13th, 1900, I see you wrote to your customers saying that your E.S. dry cell had now been on the market for over 13 years. That was a mistake as to length of time?—Yes, a usual mistake in business. As a matter of fact, it had been on the market since the latter end of 1890.

They brought an infringement action and you brought a threats action?—Yes.

In consequence of what Mr. Ford-Lloyd told you at first, did you again allege to Mr. Thompson of the plaintiff company that if they went on you could prove a prior user?—Yes

After making further inquiries from Mr. Ford-Lloyd, did you feel satisfied with his statements to you about what he had done prior to 1890? Well I had no cause to disbelieve the statements. Mr. Ford-Lloyd seemed so indefinite about the dates that our solicitors advised us we had not good ground for an action.

You got the best information from Mr. Ford-Lloyd that you could, consulted your solicitors, and came to the conclusion that if you went on you could not establish a prior user?—That is so.

Mr. William Phillip Thompson was afterwards recalled by Mr. Astbury to rebut the evidence given as to the alleged prior user of Mr. Ford-Lloyd and Mr. Braun. In the course of his examination by Mr. Shaw, Witness said the E.S. battery that was being made was exactly like the Hitchcock.

Why did you not go on with your action against the Universal in 1893?—There were three or four reasons. The first was we were rather poor at that time, having lost money over the *Discovery* newspaper; and secondly, I could not persuade our licensees to fight. I

twice asked them if they would fight, and they said they were not making so much profit over this battery as to make it pay, and we did not care to fight single-handed. I have a very big business in the patent business, and as I find in this action, it was rather more bother than it was worth, and damage to me, being away from my patent business, to attack these people. If I had to do it single-handed, or one company had to, I did not care about it. The Electric Storage Co. would not assist me or our company.

On Wednesday, June 17th, Mr. Moulton and Mr. Astbury both addressed the Court.

(To be continued.)

Mile End Guardians *v.* Hoare.

In the King's Bench Division of the High Court of Justice on 8th inst. this case came before the Lord Chief Justice, Mr. Justice Wills and Mr. Justice Channell, sitting as a Divisional Court. It was an appeal by the Mile End Guardians against a conviction by the magistrate of the Thames Police Court, who had fined them 1s. and 10s. costs, under the Factory and Workshops Act of 1901 for not having fenced certain machinery. It appeared that at the appellants' workhouse and infirmary in Bancroft Road, Mile End, there was an engine house and machinery used for the purpose of generating electric energy for lighting the buildings and also for working hydraulic lifts, and for cutting wood. The machinery included two engines, one of which was not securely fenced, and in consequence a man was killed. The proceedings were taken on behalf of one of his Majesty's Inspectors of Factories under the Act of 1901, but the appellants contended that the engine room was not a factory within the meaning of the statute. Amongst other things the Act provided that the expression "non-textile factory" should be construed as meaning any works, warehouses, furnaces, mills, foundries, &c., and dealing with electrical stations it included within its scope any premises or that part of them in which electrical energy was generated or transferred for the purpose of supplying by way of trade, or for the lighting of any street, public place or public building, or any hotel, railway, mine, or other industrial undertaking. For the inspector it was contended that the workhouse and the infirmary were public buildings within the scope of the definition laid down, but on the other hand, the appellants submitted that they were not. The magistrate held that they were public buildings, and, as already stated, convicted the guardians.

Mr Danckwerts, K.C., and Mr. J. D. A. Johnson appeared for the appellants, and Mr. Robertson for the respondent.

Mr. Danckwerts contended that the whole of the definition of factory in the statute pointed to trade or to the lighting of public buildings. The workhouse and infirmary were not, he said, public buildings, as the public had no right of access to them. Therefore, as no trade was carried on in them they were not within the scope of legislation.

Mr. Robertson said that in the sense intended by the Act, the workhouse and infirmary were public buildings.

The Lord Chief Justice said the case raised a difficult question, but he thought the Act intended to include buildings of this kind used for quasi-public purposes.

The other judges concurred, and the appeal was dismissed with costs.

Mr. Danckwerts said the Act required that a fly-wheel should be fenced whether dangerous or not, and in this case the accident happened because the man insisted on getting under the wheel.

Butcher *v.* South London Electric Corporation.

Before Mr. Justice Swinfen Eady, in the Chancery Division on 10th inst., Mr. Eve, K.C., moved in the action of Butcher *v.* the South London Electric Corporation to restrain a nuisance arising from the alleged discharge of hot water from the defendant company's boilers on to the plaintiff's garden. The defendant company alleged that the presence of the hot water was due either to the presence of a thermal stream or to the excessive heat of the weather. They had now taken the condensing water from their engines to another spot, and simultaneously the discharge of hot water from the thermal spring had ceased. The defendants having abandoned their counterclaim to a strip of 3 in. of land in plaintiff's back garden, the matter now dropped, and he asked for an order on the motion except costs of the action.

Mr. McNaghten, K.C., for the defendants, assented, but did not accept Mr. Eve's fact. There was some thermal surface water, and plaintiff having stopped defendants' ditch, the water of course flowed along the surface.

White *v.* Wallace.

In the King's Bench Division, this case was set down for hearing on 13th inst. before Mr. Justice Lawrance and a special jury. It was an action by Mr. Frederick Anthony White to recover damages against Mr. Roger William Wallace, K.C., a director of the British Aluminium Co., Ltd, for alleged misrepresentation and concealment, whereby plaintiff said he was induced to buy certain shares.

Mr. J. C. Eldon Bankes, K.C., who appeared for the plaintiff, informed his Lordship that the action had been settled, and asked for judgment on terms which were not disclosed.

Judgment was entered accordingly.

National Telephone Co. *v.* Samuel.

At the Marylebone County Court on Monday, before Deputy-Judge Fitzroy Cowper and a jury, the National Telephone Co., Telephone House, Victoria Embankment, brought an action against Mr. Henry Samuel, 11, Cleveland Square, Hyde Park, W., and Basildon House, Moorgate Street, E.C., claiming £10 11s. 8d in respect of the rent of a telephone. Mr. E. Gaine appeared for the plaintiffs, and Mr. J. Neild for the defendant.

Considerable evidence was called to show the unsatisfactory working of the instrument. The jury then stopped the case, although three or four other witnesses were to have been called for the defence. The verdict of the jury was to the effect that the telephone in question had not worked reasonably well, the foreman remarking that they considered it was "radically wrong."

His Honour accordingly gave judgment for the defendant, with costs, and made an order for the recission of the five years' agreement.

It was intimated that the plaintiff company would probably appeal.

PARLIAMENTARY.

Royal Commission on London Traffic.

Sir David Barbour presided on Friday over a further sitting of the Royal Commission on London Locomotion.

Mr. J. W. Benn, chairman of the Highways Committee of the London County Council, continued his evidence, and stated that there were 15,000 tramways and 400,000 omnibuses running in London. These vehicles would extend 27½ miles and had a carrying capacity of 170,000 passengers. An electric car carrying 65 passengers was 33 ft. 6 in. in length, and 2,615 of these vehicles covering 16½ miles would be sufficient to carry the same number of passengers as it now took 5,500 horse vehicles to carry, so that there would be an immediate saving of nearly 3,000 vehicles. When the Council came into possession of the tramways in 1899, they took into consideration the adoption of mechanical traction, and obtained an Act which authorised the reconstruction for electric traction of the whole of the then existing tramways in London, including those already acquired and those to be thereafter acquired by the Council. This Act provided that the Council shall not, except with the consent of the borough councils concerned, use the overhead trolley form of traction. The Council had adopted the conduit system of traction, and it had been found that the actual cost so far per mile was £14,041, which was 33 per cent. higher than the cost of the overhead system. Proposals were now before the Council for the electrification of the tramways on the northern side of the Thames, but they were met with the difficulty that the North Metropolitan Tramway Co. wanted the overhead system, while the Borough Councils were in favour of the conduit system. As a sort of compromise they had taken a zone with which they proposed the conduit system, and beyond that zone it was proposed to erect the trolley system.

By Sir G. T. Bartley: The cost given for the conduit system was the actual cost of that constructed, but it had to be remembered that things had been done in connection with the lines already constructed which would be of advantage to the whole system.

Sir J. Wolfe Barry: Have you found any difficulty in maintaining the conduit system?—I may say that, compared with the starting of new systems generally, our difficulties have been remarkably few, and easily overcome. We have had some difficulty with the electrical portion of the work, and already we are making some improvements on what is known as the Kennedy system; but as regards the success of the system there is no question.

You find no difficulty with mud?—No; we have had a very severe trial, and found no difficulty.

So you are thoroughly satisfied?—There is no question that the system is a success.

What system do you propose for the shallow subways?—That will depend. In one experimental piece under the new streets from Holborn to the Strand we shall use the conduit system.

Continuing, Witness said the Council had brought proposals for 95 miles of tramway before Parliament, and 80 miles had been refused for various reasons, chiefly because of the veto of local authorities. Since the Council had owned and worked the tramways on the south side, various improvements had been carried out. They had established an all-night service of cars, had extended the halfpenny fares, reduced the fares on various routes, and instituted special workmen's services with return tickets at cheap fares up to 8 a.m. Then, so far as the employés are concerned, the men were now allowed one day's rest in seven, an average 10 hours day had been established, and the wages of various classes of employés had been increased. The cost to the ratepayers of these things in round figures was £28,000. It had been frequently urged that the Council would have done better by leasing their southern lines to a company. On the northern side this was done, and the North Metropolitan Tramways Co. leased the lines. For four years the average revenue received from the company under the agreement was £39,000, but this was now to be neutralised owing to that company having sold that part of their undertaking which was outside the county. Under the agreement the Council had received a certain proportion of the receipts from the outside lines, but it now appeared that the bargain made with the company was not sufficiently stringent to continue to the Council the profit of those outside lines, and it was estimated that this would reduce the profit derived from the company by £10,000 or £15,000 a year.

Sir J. Wolfe Barry: You made a bargain either not stringent enough or under bad advice, which has lost you £15,000 a year?—The agreement is open for inspection.

Sir G. T. Bartley: Would that be the same version as the company's?—The company only say "we pay so much less."

The Chairman: Is there no remedy?—I would rather not answer that question.

Proceeding, Witness said that, after making the various improvements he had referred to on the southern side, the figures show that, in four years, up to March 31st last, they had earned a net profit of £72,910. Of course, last year, owing to the disturbance caused by the reconstruction, and the high price of forage, after payment of sinking fund and interest, a loss was shown, but now electric traction had started, they were rapidly recovering. In addition, they had set aside a reserve fund of £31,391. When the Council took over these tramways, they received an offer from the London Tramways Co. to lease them. That offer was submitted to the Controller, who reported that it would show a net profit to the Council of £14,250 per annum, which was not so good for the Council as the Council working the tramways themselves. He desired to emphasise what was said by Mr. Dickinson as to the Council, as the tramway authority, not coming within the jurisdiction of any tribunal which might be set up for dealing with London locomotion. The Council was, in effect, the sole tramway authority for London at the present time, and had endeavoured to co-ordinate the undertakings it had acquired into one comprehensive system. To allow other promoters to come into London would be to simply revert to the old system of what might be called haphazard enterprise.

The Chairman: The County Council object to letting their scheme go before the tribunal?—We might submit our proposals, and the tribunal might well regulate the rest of the transport facilities to these schemes. It would be very hard for the public authority to be placed in competition before a tribunal as to a scheme.

Continuing, Witness said the Council did not object to going before Parliament as at present for consent to its schemes, but he contended that the Council must be supreme in the matter of tramways. He knew that the Middlesex County Council had acquired the tramways and leased them to companies, and he did not anticipate that there would be any difficulty when the time came in arranging for running powers. He did not know that they would object to the tribunal settling such a matter as that. He advocated the abolition of the veto of local authorities to tramway proposals, and he believed it was not contemplated that the local authorities should use their power under the Act of 1870 against tramways promoted by the Metropolitan Board of Works. However that might be, he submitted that the power of veto was a very much more serious matter when it came to be applied to a tramway which was proposed to be a part of a large electrical scheme, than it used to be when it was applied to a horse tramway, as the vetoing of a particular line in a large scheme might result in it being impossible to connect up the existing system with a district beyond that of the vetoing authority. They did not object to the Borough Councils having the fullest right to be heard before any authority before whom it might be determined that the Council should promote tramway schemes. It had been proposed that if the veto of the Borough Councils against the Council was removed, then the veto of the Council against private companies should be removed. If that was the condition of the removal, then the Council preferred things to remain as they were.

Brighton Corporation Bill.

The Select Committee of the House of Lords, presided over by Lord Hatherton, which has been considering the Brighton Corporation Bill which seeks to empower the Corporation to construct new tramways after a week's adjournment, concluded their examination of the Bill on Thursday. The first part of the proceedings has already been published in the Electrical Review.

A number of local witnesses were called in support of the case of the opposing Dyke Road frontagers.

Mr. Blennerhassett addressed the Committee on behalf of the Duke Road frontagers, and pointed out that as the Committee had already thrown out the Montpelier Road section, nothing now remained but a mere fragment of what had been from the first a bad and imperfect scheme.

Mr. Pember, K.C., replied on behalf of the Corporation, and said that the routes proposed by the Bill would open up the whole of the north-west end of Brighton with the centre of the town.

The Committee found that the preamble of the Bill was proved as regarded the Dyke Road, Goldsmid Road and Queen's Road Tramways, and also with regard to the Terminus Road provided that this tramway was connected with the Queen's Road line.

Mr. Paddon, on behalf of the Brighton and Hove Gas Co., asked for the insertion of a clause to protect them from electrolysis.

Mr. Cash, the general manager, said the value of the mains laid in Brighton was £50,000 or £60,000. The pipes had been damaged by the action of the electric current. They had been the subject of correspondence with the Corporation, who declined to admit any liability. The bulk of the tramways at Brighton had been laid without the company receiving the statutory notice which the Corporation should have served under the Tramways Act. There was precedent for such a clause, as it had been inserted in other Bills for the protection of gas companies. They anticipated that a great deal of damage would be done to their pipes.

Mr. Stanley Cooke, chief inspector of the Gas Co., gave specific instances of damage done to the gas pipes. He alleged that in June, 1896, two service pipes in Ship Street were absolutely destroyed owing to contact with the electric cables used for electric lighting. The Corporation foreman admitted that there had been a leakage of current. Other damage had occurred due to electrolysis which had been admitted by the manager of the Hove Electric Lighting Company.

In cross-examination, Witness admitted that the company presented a similar petition against the Worthing and Hove Tramway Bill, and no special protection was afforded them. He understood now that the company's case was not gone into by the Committee who considered the Bill.

Mr. W. Hole, superintendent of the Leeds Corporation gas mains, was called and stated that on February 25th last a 1-in. service pipe was found deeply pitted by electricity, and in Kirkgate a pipe bedded in concrete was eaten through. They had found other mains at Kirkgate and at Glasshouse Street eaten away. They attributed this to the electric current, for the pipes were sound away from the tramway. In the cases he had quoted the farthest distance the pipe was from the tramways was 30 yds.

The Chairman said the Committee were quite satisfied that under certain conditions pipes could be fused by electricity.

Prof. W. E. Ayrton was examined at some length on the subject of electrolysis arising from leakage of the electric current used for tramways. The Board of Trade regulations diminished the leakage, but they did not stop it, and the greater the number of cars the greater was the tendency for the current to leak into gas and water pipes. Greater facilities were offered at certain places for the current to leave the pipe, and consequently the damage if spread over a few inches of pipe became enormous. He considered it most desirable that the Gas Co. should get a protective clause.

In answer to Mr. Pember, Witness said he was quite sure now that the Board of Trade regulations were insufficient.

Sir Ralph Littler, K.C., put in the clause asked for as follows:—"If at any time it be proved that any injury or damage to any mains, pipes or apparatus of the Brighton and Hove General Gas Co. shall have resulted from the generation, distribution or use of electrical current, nothing in this Act or any Act or order shall relieve the Corporation from liability to compensate for such damage." He contended that this was a serious matter for the Gas Co., and they were fully entitled to the protection they sought.

In reply to the Chairman, Mr. Talbot said the Corporation strongly objected to the special clause. The Board of Trade took the view that their new regulations applied to such cases as this, and the Corporation were willing to make it clear that they would be subject to any regulations which the Board of Trade might make.

Mr. Baggallay, K.C., referred to the inquiry of the Joint Committee on the subject, and said the conclusion arrived at by that Committee was that the escape of electrical current could be reduced to a practically negligible quantity, although none could say it was absolutely possible to prevent any escape under any condition whatever. The Board of Trade framed regulations on that report, and the model clause was put in the Brighton Corporation Act of 1900, under which the tramways were running. The Board of Trade could amend their regulations from time to time as fresh evidence cropped up. He objected to the special clause, as it would be practically going back upon the spirit of the report of the Joint Committee; but he was perfectly willing to accept a clause making it clear that, if the Board of Trade framed fresh regulations, they should apply in the case of the Brighton tramways.

The Committee considered the matter in private, and announced that they were of opinion that there should be a clause protecting the Gas Co. as regarded the tramways allowed in that Bill. This could be done by omitting the words "or in any Act or order."

Mr. Paddon said there would be difficulty in identifying damage as having arisen from current distributed for one particular purpose.

The Chairman said that they could not go behind what was done by other Committees for other tramways.

Mr. Baggallay: I take the decision to be that, if the gas company can prove that any injury is done to their pipes or mains by electricity used upon the tramways authorised under this Act the company will be entitled to compensation.

The Chairman: Yes.

The Committee proceeded to consider further proposals in the Bill dealing with the Corporation electricity supply, under which power was sought to extend the area of supply to include Rottingdean, Ovingdean, Patcham, Falmer, Preston Rural, Hangleton, Old Shoreham, Kingston-by-Sea, Aldrington, Lancing, West Blatchington, Portslade, New Shoreham and Southwick. The last three districts had been struck out.

Mr. Baggallay said the Corporation would undertake not to supply electricity without the written consent of the local authorities, and the price to be paid in any part of the extended area would have to be agreed upon by the Corporation and the local authorities, and approved by the Board of Trade.

Mr. Paddon, for the gas company, asked for the insertion in the Bill of the Bermondsey clause.

The Committee decided that such a clause should be inserted.

Mr. Baggallay suggested that the clause inserted should be that the price to be charged by the Corporation for electricity to be supplied in any portions of the parishes of the extended area should be such prices as were to be agreed between the local authorities and the Corporation, and approved by the Board of Trade, but that such prices should be fixed only for the then ensuing year at such rates not exceeding the maximum rates specified by the Brighton Electric Order, 1883, in order that, so far as was reasonably practicable, the revenue should not be less than the expenditure for that area in connection with the supply of the parishes.

The Committee signified their approval of the clause, and the preamble of the Bill was declared proved.

Seaforth and Sefton Junction Railway Bill.

On Thursday and Friday of last week a Select Committee of the House of Lords, presided over by Lord Herries, considered the Bill of the Seaforth and Sefton Junction Railway Co. Mr. Ram, K.C., Mr. H. Lloyd, and Mr. Vesey Knox appeared for the promoters, the opponents, the Lancashire and Yorkshire Railway Co., being represented by Sir R. Littler, K.C., Mr. Balfour Browne, K.C., and Mr. Acworth.

Mr. Ram, in opening the case, said that the Bill had for its object the construction of a short but very important railway 4¼ miles in length, constructed chiefly on a viaduct to join the Liverpool Overhead Railway Co.'s system at Seaforth with the Southport and Cheshire Lines Extension Railway at Sefton. The objects of the extension were to give more facilities for local traffic, to provide the connecting link of a through route direct to Southport, and to bring down minerals from the hinterland of Lancashire and Yorkshire to the Liverpool docks. The Liverpool Overhead Railway had been a great success; but if the proposed extension were carried out, its usefulness and success would be greatly increased.

Mr. S. B. Cottrell, the engineer and manager to the Liverpool Overhead Railway, gave evidence in support of the Bill, as did Sir Douglas Fox. The latter witness said that he designed the Overhead Railway, and it was intended at the time it was constructed that it should be available for goods traffic. Local evidence was also tendered in favour of the Bill, with the object of showing that the extension would meet a want for additional railway facilities.

Mr. Aspinall, the manager of the Lancashire and Yorkshire Railway, gave evidence in opposition to the scheme, which, he said, would compete unfairly with his company's railway. Southport, which was really a suburb of Liverpool, had, he contended, been practically made by the facilities which his company had afforded in the matter of railway communication. Their system was being electrified, and he hoped that the trains would be run electrically before the year was out. At present it took about 25 minutes to go to Southport from Liverpool, but when the line was electrified they hoped to run quicker. Within a few months there would be through electrical railway communication from Southport over his company's lines and the Overhead Railway.

After hearing counsel in opposition to the Bill, the Committee found the preamble proved, and ordered the Bill to be reported to the House for third reading.

Municipal Trading Committee.

At the resumed sitting on 9th inst., Mr. Cockerton, Local Government Board auditor, examined by the Earl of Crewe, said he was appointed auditor to the L.C.C. accounts in 1901. He regarded it as a very important function of an auditor to inquire carefully into the allocation of moneys to particular departments. There were two large accounts of the L.C.C. which were carried out on the profit and loss principle—those relating to tramways and to the housing of the working classes. In considering what amounts should be allocated to the loan and capital account and what amount to the general account, he exercised the very greatest care when the vouchers were produced to him in seeing that the capital payments were carried to the appropriate accounts in the ledgers. He thought that the lines could be sufficiently strictly drawn to enable him to judge as to what particular account each item should be placed under. If any question should arise as to the necessity of having the accounts altered or corrected, he took it that it would be fully within his competency to have them corrected. He should say that it was possible and probably desirable to institute a standard form of accounts for municipalities—excluding the L.C.C., whose accounts were too huge to be compared with any others. Speaking generally, he should say that the accounts of the L.C.C. were very well kept. With regard to the tramway accounts there were some transactions that had not yet come before him, into which he would feel it his duty to go very carefully and exhaustively. He referred more particularly to the question as to what proportion of money spent on street widenings for tramway purposes should be charged to the undertaking, and what proportion allocated to improvements. There had been practically no surcharges or disallowances of the L.C.C. accounts since 1890, when the first Government audit was held. He did not approve of vexatious or trifling disallowances, but was of opinion that the power of surcharge should be used very cautiously indeed.

Replying to Lord Zouche, Witness said he did not believe that any of the Local Government Board auditors were chartered accountants. They were, however, men of large experience, and it was not necessary to be a chartered accountant to know something of accounts. He thought that legal knowledge was of importance to an auditor.

By Mr. Powell Williams: In making his audit, he would have regard to the amount set aside for depreciation of plant.

Mr. Norbury Williams, an elective auditor of the Manchester Corporation since 1893, gave evidence bearing on the importance of retaining the office of elective auditor, who, he said, being more acquainted with the doings of the Corporation, was more useful than the professional auditor in checking wrongdoing or excessive expenditure. Under the present condition of affairs, he said that any corporation which did not embark in municipal enterprises would find itself falling behind, and he did not see why a corporation should not at least supply gas, electric light, tramways and water. The municipal debt of Manchester in 1893 was £11,716,000; in 1896 it was £15,328,000; in 1889, £16,143,000; 1902, £18,144,000; while this present year it had increased to £19,610,000. He was not alarmed at those figures, because they had good, solid assets amounting to several millions more than the debt. On several occasions he had called attention to items in the accounts which had been passed over by the professional auditors. Under the law, a member of a corporation who traded direct with the corporation was ineligible to retain his position; but there was growing up a practice whereby members of such bodies formed limited liability companies, and then they could supply the Corporation without doing an illegal act. Personally, where a member of any public body was interested to the extent of more than 10 per cent. in any company, he would like to see it made illegal for that company to do any business with the corporation. Recently there was a case in Warrington where the mayor of the borough at the time held 57 per cent. of the shares in a company which did thousands and thousands of pounds worth of business with the Corporation. He regarded such a practice as very demoralising, and thought it ought to be prevented.

By Sir James Woodhouse.—In Warrington, companies in which members of the Council were interested had supplied the Corporation with electric light fittings, building materials, &c., and there had been eleven meetings of the burgesses held to protest against the system. He admitted that it was perfectly legitimate, but considered that it was very demoralising.

Mr. W. S. Carver, president of the Institute of Municipal Treasurers, said that his Society had often considered what reform could be suggested to improve the system of municipal audit, which it was obvious was susceptible of improvement in many directions. The ideal system would be one in which the auditors should be expert and qualified accountants appointed by the municipalities whom they served, subject to the superior authority of the Local Government Board confirming such appointment. They should have powers of surcharge, subject, of course, to a reasonable appeal. If elective auditors were retained he would like to see some provision inserted that they should be trained accountants. He thought it was very important that where loans were granted for municipal works it should not be for a longer term of years than the life of the plant into which the money was put.

The Chairman: In the case of the works of any undertaking becoming obsolete through new inventions, how would you deal with that in a question of accounts?—If the Corporation had provided a reserve fund for such a contingency, the matter would be simple if the reserve fund were sufficient, but if not, two courses would be open—one to charge the revenue account for the year with the extraordinary expenditure, and the other would be to apply to the sanctioning authority for fresh borrowing powers, asking them to grant a loan for such work. Municipalities which traded should do so on strictly commercial lines, the same as an ordinary private company.

Replying to Lord Rothschild, the Witness said it might be desirable for municipalities to publish a detailed statement of their assets, but it would be a very difficult thing to do.

Mr. Hartley, a member of the Bradford Town Council, also gave evidence. The witness expressed himself as an out-and-out advocate of municipal trading, and said that if Corporations were allowed to supply electricity, tramways, gas, water, &c., he did not see any reason why they should not supply everything that the citizens required. He would extend the powers of municipal trading even to the provision of luxuries.

On Monday evidence was given by Mr. J. M. Fells, accountant, and a member of the Council of the Industrial Freedom League. In answer to questions by the Chairman, he said that a comparison between the debt of a municipality and the share capital of a company was fallacious. It seemed to him that the real comparison should be between the local debt and the debentures raised by a company. As to the sinking fund of a municipality and the amounts set aside in the depreciation fund of a company, he saw no comparison at all, for depreciation represented the wear and tear of plant which went on whether any provision was made for it or not, and it was in point of fact a charge against the ordinary working, while the sinking fund was the provision for the redemption of a liability. The plant for which the debt was incurred might be absolutely useless by the time the debt was paid off. In Scotland this difference between depreciation and sinking fund was recognised, but in the English boroughs it was not so.

The Chairman: What have you to say as to the periods allowed by the Local Government Board for the life of plant?—From the details given to the Committee by Mr. Kershaw on the repayment of loans by local authorities, I find that the period for the first installation of the electric light is 25 years; for additional work after the undertaking is established 30 years; cables 30 years; transformers 20 years; switches and switchboards 30 years; dynamos 20 years; meters and instruments 15 years; and arc lamps 10 years. I do not think the life of the plant can be so long as the period of the loan, at any rate, as regards electric lighting plant.

So you consider these terms excessive?—Certainly.

But I suppose these terms have been carefully thought out by the Local Government Board?—Of course, electricity is a comparatively new science, and there has not been much data on which to form accurate calculations with regard to the life of electric plant.

But we must assume they tried to keep on the safe side?—No doubt.

Proceeding, Witness advocated the appointment of professional auditors, subject to the approval of the Local Government Board, to audit municipal accounts, and he saw no difficulty in laying down a standard form of accounts.

Have you any information to give with regard to electric lighting accounts?—In Sir Henry Fowler's second report the amount of capital expended by the local authorities in England and Wales in electric undertakings was £12,508,997, and the average annual loss on these undertakings was £11,707. The total amount set aside for antiquation and depreciation was £19,970, but that was rather better than the first return, which showed that there was only

about one-tenth of 1 per cent. put to depreciation. Now it is about one-fifth.

Have you any instances to give of different boroughs which set aside sums for depreciation?—Bristol provides to some extent, not made on any fixed basis; Stafford 1 per cent. on the annual outlay; Halifax on no fixed basis; Huddersfield sets aside available surpluses for depreciation and contingencies; Leeds and Sunderland no fixed basis. There has been a good deal of controversy lately—but I have no figures to prove it—that the 2½ millions invested by the London local authorities shows no profit, and would show a loss if depreciation were provided. These undertakings are in their early stages, and perhaps it would be unfair to make any general conclusion with regard to them.

Witness proceeded to deal with the Blackburn Corporation gas accounts, which carried a loss to the renewal account, and set out the debt as an asset in the accounts, justifying such a course by the statement that money expended on capital account in excess had been charged to renewal and repairs account. The auditors of that borough stated with regard to the tramway undertaking that the results were after providing the necessary instalments for the repayment of the loan debt, but without making any provision for depreciation on the capital assets of the undertaking. He deprecated the transferring of a balance from one department to another, and held that any surplus should be devoted to cheapening and improving the service. He contended that where a municipality started an undertaking, instead of going on the rates for any loss which might result, the charges to users should be fixed so as to avoid any charge on the rates, and pointed to the course pursued by Parliament last year in inserting what was now known as the Bermondsey clause in the Bermondsey Electric Lighting Order. By this clause it was incumbent on the local authority after the first year's trading to cause a proper balance-sheet to be made out, and then fix the charges so as to avoid a loss. A similar clause was inserted in the Stoke Newington and Woolwich Confirmation Orders. In 1890, when the Dundee Corporation applied for power to take over the Dundee and Broughty Ferry Tramways, they were opposed by two railway companies whose lines ran parallel to the tramways. It was pointed out that the Corporation might carry passengers at unremunerative fares, and take the traffic away from the railway, and might make the loss good out of the rates, to which the railway companies were contributors. The Committee inserted a clause to the effect that once in every year after the first year's working the treasurer should lay before them a statement and balance-sheet of the tramways undertakings, so that they might fix the fares for the ensuing year. Similar clauses were inserted in the Aberdeen Corporation Tramways Bill and the Rochdale Corporation Bill, while in the Rhondda Urban District Council Bill a clause was inserted to compel the Council to lease the tramways to a company. He thought that the consent of the ratepayers should be obtained before the municipality entered into any trading undertaking, and it should be more than a bare majority.

Replying to Sir J. Stirling Maxwell, Witness said he had had experience with regard to electric lighting plant, and he believed electric lighting plant did not last 10 years.

By Sir J. Woodhouse: If an arc lamp were replaced out of renewals account he would not complain.

The Committee adjourned till Thursday.

Beckenham Tramways.

The Bill promoted by the Beckenham Urban District Council came before a Select Committee of the House of Lords last week, presided over by the Duke of Bedford. Mr. Balfour Browne, K.C., Mr. Fitzgerald, K.C., and Mr. Vesey Knox appeared for the promoters. The L.C.C. and the South-Eastern Railway Co., who opposed the tramway clauses of the Bill, were represented by Mr. Erskine Pollock, K.C, and the Hon. Evan Charteris, and Sir R. Littler, K.C., Mr. Pember, K.C., Mr. Boyle, K.C., and Mr. Clode respectively.

Mr. Balfour Browne, K.C., in opening the case for the promoters, said that by the Bill the Beckenham Urban District Council sought powers to construct three lines of tramways, to be worked by electricity. Tramway No. 1, which was something over a mile in length, was to begin at the Penge boundary of the district and end in High Street, Beckenham. A junction was to be formed with existing tramways in Penge, which would thus afford a through connection from Beckenham to the Crystal Palace and Norwood. Tramway No. 2, which was to be five furlongs in length, was wholly in the Beckenham district, passing from the Penge boundary to Kent House Road. The third tramway for which powers were sought was about 300 yards long, and would be a continuation from Kent House Road to High Street, Sydenham. The tramways, when constructed by the Council were to be leased to the British Electric Traction Co. In connection with the construction of the tramways, street improvements were to be carried out at an estimated cost of £63,250.

Mr. J. W. Benn, chairman of the Highways Committee of the L.C.C., gave evidence in opposition to tramway No. 3 which would extend to the metropolitan borough of Lewisham. He said that the Council objected to anyone either owning or working a tramway inside the administrative county of London. The Council was the tramway authority, and preferred to own and work all the tramways within their area. He admitted that Parliament had made exceptions to this rule, but only in cases where the Council had given its consent.

After hearing other evidence, the Committee found the preamble of the Bill proved so far as the tramway portion was concerned, on condition that a clause was inserted securing to the L.C.C. running powers over and a connection with tramway No. 3; also giving the Council power to buy up the line at the end of 21 years.

South Staffordshire Tramways.—Lord Morley's Committee of the House of Lords, on July 7th, found the preamble of this Bill proved, and it was ordered to be reported to the House for third reading.

Wigan Corporation Tramways.—On Tuesday last week, Lord Morley's Committee of the House of Lords ordered this Bill to be reported for third reading.

Baker Street and Waterloo Railway Co.—On Tuesday last week this Bill was before Lord Morley's Committee of the House of Lords, and was ordered to proceed to third reading.

Standing Orders.—The Standing Orders Committee of the House of Commons have decided that Standing Orders may be dispensed with, and the parties be allowed to proceed with their Bill in the case of the Gosport and Fareham Tramways Bill, and the North-Western Electricity and Power Gas Bill

Petitions.—The following amongst other petitions have been deposited in the Private Bill Office:—The Bradford Commercial Joint Stock Bank against the Bradford Corporation Bill; the Salford Corporation and the Sale U.D.C. against the Manchester Southern Tramways Bill; the West Riding County Council against the Horsforth Order contained in the Tramway Confirmation Order No. 2; the South Eastern and Chatham Railways against the Erith Tramways; the Great Western Railway against the Birmingham District Tramways; and the Provincial Water Companies' Association against the Somerset and District Electric Power.

Petitions Withdrawn.—The Poole and District Electric Traction Co. and the Poole Corporation have withdrawn their petitions against the Bournemouth Corporation Tramways Bill; the Metropolitan Electric Supply Co. have withdrawn their petition against the Willesden U.D.C. Bill.

Bournemouth Corporation Tramways.—This Bill which has already passed the House of Lords, came on Friday last before the Deputy Chairman's Committee of the House of Lords. The preamble of the Bill was found proved, and it was ordered to be reported for third reading.

Nottinghamshire and Derbyshire Tramways.—When the Bill was before the House of Lords a number of the tramways proposed were dropped. There was no opposition offered to the remainder, and on Friday the Bill came before the Unopposed Committee of the House of Commons and was ordered to be reported to the House.

Dudley, Stourbridge and District Trammays.—On Friday this Bill came before the House of Commons Committee. The preamble was formally proved, and it was ordered to be reported for third reading.

Worthing Corporation Tramways—There was no opposition to this Bill, and on Friday the preamble was found proved by the Unopposed Bill Committee of the House of Commons.

Poole and District Electric Traction Bill.—All opposition to this Bill having been withdrawn, it came on Friday before the House of Commons Committee on Unopposed Bills, and was ordered to go forward for third reading.

THE CONDUIT v. THE TROLLEY SYSTEM.

The L.C.C. Decides to Ask the Views of the Borough Councils.

The London County Council on Tuesday resumed the consideration of a report by the Highways Committee, who recommended that authority should be given for the preparation of plans and specifications (1) for the reconstruction on the overherd trolley system of various tramways leased to the North Metropolitan Tramways Co; and (2) for the building of several new authorised lines on the same system, all the routes proposed being situated on the northern side of the Thames. When the question was before the last meeting of the Council, an amendment, proposed by Mr. Howell J. Williams, and seconded by Mr. A. M. Torrance, was under discussion, having for its object the referring back to the Committee of the first recommendation respecting the conversion of existing tramways to the overhead system.

Sir William Collins—on the question coming before the Council on Tuesday—asked the chairman of the Highways Committee if he would agree to further postpone the consideration of the scheme in view of representations which had been made. He understood that a conference of the London local authorities would be held shortly to discuss the subject, and it would be well for the Council to hear what the Borough Councils said before going further into the matter.

Mr. S. Low expressed the hope that if all action in regard to the proposals before the meeting was deferred, the chairman would also undertake to postpone any action in relation to the resolutions passed at the previous meeting when various tramway conversions to the conduit system were approved.

Colonel Rotton submitted that the adoption of the suggestion of the previous speaker would mean the reversal of the decision arrived at a week ago. If the consideration of the scheme was adjourned, it should surely not be in order to rescind the resolution agreeing to the conduit system for various tramways.

Lord Monkswell (chairman of the Council) at this point ruled that the question before the meeting was the amendment to the recommendation.

Mr. J. W. Benn asked the Council for something more definite than a mere reference back to the Committee, who really wanted to know what to do. He had hoped Mr. Beachcroft would have given some light on the subject, but as far as he could gather, that gentleman had no suggestions to make.

Mr. A. M. Torrance, who seconded the amendment at the previous meeting, now asked whether it would be in order to withdraw it, he having the consent of the mover to do so. The amendment was then withdrawn.

Mr. N. W. Hubbard then moved a further amendment to defer the consideration of the recommendation until the Council had ascertained the views of the borough councils. The latter were the masters of the situation, and it seemed to the speaker that their opinions should be obtained before devoting further time to the matter. That point had already been before the Highways Committee, who being equally divided, were unable to arrive at a conclusion, but he hoped the Council would decide in favour of seeing what the borough councils would permit the County Council to do.

Mr. G. H. Radford, who seconded the amendment, said that it was probable the Islington Borough Council would have the strongest objections to the trolley in the Caledonian Road and other thoroughfares; but it was as well that that authority and the others should have an opportunity of considering the matter on its merits.

Mr. D. S. Waterlow remarked that if the question was referred to the borough councils, it was very important that full and complete details of the engineering difficulties along some of the roads should be placed before those authorities.

Mr. J. A. Allen agreed that full particulars should be forwarded to the borough councils so that each scheme might be dealt with on its merits.

Mr. R. M. Beachcroft contended that the point before the Council was really a question of policy; but it would be a wrong step to refer the matter back, to consult the borough councils before the County Council had settled something in the way of policy. He considered that the trolley system should be introduced where it was suitable, as, otherwise, the districts might have to wait for years for the introduction of the conduit method. The Council's officers were of opinion that the conduit system would be financially impossible throughout London, and the matter ought to be regarded from a financial standpoint. The time had come when a difference of £14,000 per mile of track was worthy of consideration. Mr. Benn had asked what alternative they proposed, and in reply to that he would say that the report before the meeting was conformable to his views. There should be give and take. Where the overhead could be adopted it should be introduced, and as they knew that both systems could be worked in conjunction with each other, the Council ought to have one established policy of adopting both methods where possible. It had been said that the North Metropolitan Tramways Co. would prefer the cheaper system; but he had not yet heard that the company had practically declined to allow the conduit on the northern lines. The speaker, in conclusion, said that he hoped the matter had been made quite clear, because it had been stated in the newspapers that the North Metropolitan Co. had vetoed the conduit system, but if that was the case it had not been before the Highways Committee.

Mr. J. S. Fletcher remarked that some of the outlying districts were strenuously opposed to the use of overhead wires, and he was in favour of supporting the amendment.

Mr. McKinnon Wood observed that he had never said anything which ought to be taken to mean that he was indifferent to the cost of the work undertaken. If the amendment was carried, he was inclined to think that it would probably facilitate matters. The borough councils would be able to consider the schemes on their merits, and the Committee would have an opportunity of explaining to them the difficulties, some of which it would be almost impossible to overcome in the case of the conduit.

The amendment, on being put to the vote, was adopted unanimously, the effect being that the proposals for trolley lines will now be submitted in detail to the borough councils for consideration, and a further report on the subject presented to the County Council later in the year.

ELECTRICAL MATTERS AT THE L.C.C.

The London County Council decided at the meeting on Tuesday to lend £2,790 to the Stepney Borough Council for electric lighting purposes, and to sanction the borrowing by the Hackney Borough Council of £6,500 for similar works.

The Tramway Financial Position.—The Highways Committee submitted long reports in relation to the receipts and expenditure on the Council's tramways for the year ended March 31st, 1903, and to the income from the lines leased to the North Metropolitan Tramways Co. for the same financial year. It appears that the working of the South London lines by the Council has resulted in a loss of £2,250 for the year. This deficiency is mainly attributed to loss of receipts from the dislocation of traffic during the reconstruction of sections for electric traction, and it is expected that when the work of transformation has been completed the receipts will be largely increased. With regard to the leased tramways, the accounts show a surplus revenue of £37,794, but owing to the before-mentioned deficiency and a deficit of £5,855 on general account, the available surplus, including a slight balance from the preceding year, only amounts to £29,869, of which £.0,000 is transferred to the relief of the county rate, and the balance carried forward to the next account.

The Pimlico Power Station.—The Council approved an estimate of £500 for the preparation of plans, survey of site in connection with the power station proposed to be erected on land acquired for the purpose at Pimlico. As the Highways Committee pointed out, it was intended that this station on completion should be used for the working of the existing and authorised tramways in the western portion of the county both north and south of the river, whilst the Greenwich power station would at first serve for the tramways south of the Thames. It was proposed to operate from the Pimlico station the whole of the Council's (northern) tramways west of a line roughly drawn from north to south through the centre of the county, as well as the portions in London of the systems of the London United Tramways and the Harrow Road and Paddington Tramways Companies, which would become purchasable by the Council in 1909 and 1907 respectively. It was, moreover, to be borne in mind that the Council had already obtained powers to construct new tramways from Hammersmith Broadway to Putney Bridge, and there was prospect of obtaining powers this session for three miles of line in the same district. In these circumstances the Committee considered it desirable that steps should be at once taken with a view to the erection of the Pimlico generating station as soon as Parliamentary powers had been obtained for the purpose, and the expenditure of £500 was proposed with the object of procuring preliminary plans and the making of surveys of the site before detailed estimates could be furnished.

Plant for the Greenwich Station.—The Highways Committee reported having had under consideration the question of taking steps to provide the plant and machinery for the Greenwich power station, before ceasing to use the temporary stations at Loughborough Junction and Deptford. It was probable that by the time the Greenwich station was finished the whole of the Council's tramways south of the Thames would have been reconstructed, and it was hoped that the construction of the new authorised lines on that side of the river might be proceeded with at an early date. It was estimated that over 600 cars would be required for these tramways, and plant of 20,000 H.P. would have to be provided. There would then be 15,000 H.P. available for working the lines at one time—that is to say, a corresponding amount of plant to that which would be in use at Loughborough and Deptford by the end of the present year, namely, 10,000 H.P.—with an additional unit of 5,000 H.P. in respect of additional lines, while there would be a spare set of plant of 5,000 H.P. Two of the 16 water-tube boilers which were being obtained under contract from the Stirling Boiler Co. were in use at Loughborough, and there would be 14, of those first ordered, free for use at Greenwich. The tramways manager was of opinion that 10 additional boilers would be required to work the four sets of plant of 5,000 H.P. each, which was the maximum which the first portion of the Greenwich station would accommodate. Under the County Council agreement with the London Electric Supply Corporation, the latter had the option of purchasing the two 2,500-H.P. sets now being installed at its premises at Deptford, and it was probable that the company would exercise that option. Should it not be possible to dispose advantageously of the remainder of the plant used in connection with the temporary arrangements for working the tramways, the plant could be utilised for the second portion of the Greenwich station or at the Pimlico station. As the Council was aware, it was proposed that a considerable portion of the northern tramways should be operated from the Greenwich station, and having regard to the length of time which would elapse before the additional plant could be obtained and erected at the station, the Highways Committee considered it desirable that the Council should at once invite tenders for the plant. They therefore recommended the Council to approve an estimate of £148,500 for three 5,000-H.P. steam generators, 10 water-tube boilers with mechanical stokers, pumps, tanks, steam exhaust and feed piping, &c., economisers and switchgear and connecting cables, &c. The consideration of the recommendation was postponed for a week.

CORRESPONDENCE.

British Industries and Foreign Competition.

I have been much interested in reading the "wail" of Mr. G. Byng contained in the speech printed in your last week's issue. Quite apart from the question of protection or non-protection, it has struck me, as one who was present at the opening of the extensions of the General Electric Co.'s lamps works, that there was very little sign of deterioration owing to foreign competition. It is all very well for Mr. G. Byng to put his side of the question forward, and to anticipate the sorrowful time when lamps will be sold at so cheap a rate, but it is very evident from the results which have no doubt attended the gallant efforts of the directors of the General Electric Co., that Free Trade has not been so harmful to British interests, as represented more particularly by the "Robertson" lamp, as Mr. Byng would like to make out.

I hope someone more capable than myself will answer the arguments contained in Mr. Byng's one-sided speech. It was only the above peculiar aspect of the case which occurred to the mind of

Anti-Protectionist.

July 8th, 1903.

Wiring Specifications.

With further reference to the letter you so kindly inserted in your last week's issue, I wish to bring to your notice another clause, which, in my opinion, is as outrageous as the other one. It reads as follows :—

"The contractor must state particulars of three recent jobs, which are of the same character and size to the one now to be estimated for, *and he must in addition give the prices he received for doing the same.*"

You will see that this clause is equally as impudent and useless as the one to which I drew your attention last week.

Wiring Contractor.

The Qualifications of Technical Teachers.

I have read with much interest Lord Rosebery's letter *re* the London-Charlottenburg Technical Institution, and the question has arisen in my mind, What will the students, after having passed through such a course, do? Will they further swell the ranks of the teaching profession, and so make it utterly impossible for the man who *has* had a good technical college training, and, say, seven years in works, to obtain a teaching post? It would be an interesting matter to inquire into the works experience (*and wages earned therein*) of some of those who are now qualified teachers (?) in electrical engineering in our London Technical Institutions.

Unfortunately, it seems more beneficial for those desiring a teaching post to spend two years working for a scientific degree than to spend three years in a factory, whether at the bench or in the drawing office.

A.I.E.E.

[We fear that our correspondent's complaint is only too well founded, especially in regard to teachers in electrical "engineering." But what can be expected, when the salaries offered are no better than those of a fitter or engine driver ?—Eds. Elec. Rev.]

The Constitution of Atoms.

My attention has been called to a leading article in your current issue, wherein the writer criticises matters which he fails to understand. I suppose I must assume that in the present state of scientific education it is possible for others to fall into the same blunder. May I, therefore, state that the square of a negative quantity is positive, and that accordingly the masses of an aggregate of equal opposite charges are to be added together and not subtracted. The inertia of a charge is proportional to its electrostatic energy, and is independent of sign.

Oliver Lodge.

University of Birmingham,
July 11th, 1903.

[We regret to learn that we failed to understand Sir Oliver Lodge's explanation of the electrical origin of the mass of the atom. The report of his Romanes lecture in the *Times*, on which our criticism was founded, possibly lacked much of the detailed explanation given in the lecture as delivered. We have now the advantage of the further explanations which he gives in his letter, but we fail to see that the elementary facts that he communicates to us therein affect our criticism in the least degree. Nothing in our leading article is inconsistent with the statement that the square of a negative quantity is positive, or with the statement that the inertia of an electrical charge is proportional to its electrostatic energy. What we said was, in effect, that if an atom were made up of equal numbers of positive and negative electric charges, these charges would exactly neutralise each other, and the aggregate would be electrically neutral, and having no external electrostatic field would have no electrostatic energy. The electrostatic energy of the aggregate being practically zero, where does the electrical inertia come in? The square of a negative zero is, no doubt, positive, but that does not help us much. We do not profess to understand everything about these "matters;" and who does? Certainly not the learned doctors, if we are to judge from their differences. (J. J. Thomson, for example, is opposed to the view that mass is to be accounted for electrically.) Our article was an attempt to criticise Sir Oliver's modern views on atoms from the point of view of the plain electrician, who likes to form some concrete representation of hypothetical phenomena, rather than juggle with mathematical symbols.

We note that Sir Oliver does not object to our equally severe criticisms of his atomic "nebular hypothesis;" is this to be taken as an admission that it is untenable? "In the present state of scientific education," these questions ought not to be left in doubt, if they can be settled by *ex cathedrâ* utterances from Birmingham.—Eds. Elec. Rev.]

A Record in Electric Generators.

Together with the progress of the great modern systems of distribution of electrical energy, we have observed the rapid development in electrical stations of more and more powerful engines for its production. A few years ago engines of more than 1,000 H.P. were rare in central stations; now they are no longer looked upon as extraordinary, and at Berlin, for instance, we may see enormous engines of 5,000 H.P. working dynamos. At Frankfort and at Milan steam turbines, more modern engines of the same power, fulfil the same purpose. Up to the present, the record has remained with America, New York, for instance, possessing mastodons, each supplying the enormous power of 8,000 H.P. to the dynamos coupled on to them.

But this time, old Europe will not have been left behind long. We hear that an electrical company at Essen, in Prussia, has just ordered from a Swiss firm a steam turbine with dynamo, the power of which will amount to 10,000 H.P. Notwithstanding its enormous power, the new engine will be extraordinarily reduced in its dimensions, since it will be less than 3 metres high, 3 metres wide, and about 7 metres long. Moreover, it is guaranteed that its consumption of steam will be less than that of the best steam engines known; thus, besides the enormous power that will be furnished by the new engine, it will be interesting in other respects, and will constitute a real advance in industrial progress.

E. Guarini.

REVIEWS.

Continuous Current Dynamos and Motors and their Control. Completed by W. R. Kelsey, B.Sc., A.I.E.E., F.Ph.S. Manchester: The Technical Publishing Co., Ltd. 5s. net.

The keynote of this book is given on the second page :—"The manufacture of dynamos and motors is daily becoming more the work of mechanical engineers. . . . Probably, in years to come, we shall see dynamos and motors designed and made in engineering workshops quite as freely as steam engines are to-day. Under these circumstances it behoves the practical engineer who is anxious to keep abreast with the times to bestir himself. Not only will he have to deal with steam engines, shafting, and machinery, but he will also be expected to manufacture and put in the dynamos and motors as well."

The intention is excellent, and has been fairly well carried out, although there is a lapse here and there into too much formulæ and the calculus. Also in places some of the information is of little practical use, thus disc armatures were hopelessly out of the running from the first; they were, in fact, an electrician's job rather than an engineer's. Then, again, many forms of armature end connections are shown, which have been entirely wiped out of existence by the barrel winding.

Vulcanised fibre, too, is a most undesirable material anywhere, certainly to make air spaces in the core. The proper method of doing this is to punch depressions in one of the side plates.

As with most technical books, this publication suffers from the lapse of time between writing it and the date of publication; thus we read that a dynamo of 3,000 H.P. at 100 revolutions is *now being built* by the E.C. Co. for Manchester. This fixes the time of writing about five years ago, and naturally there have been many changes since then. The latter portion, however, for which Mr. Kelsey appears to be more particularly responsible is fairly up to date, and

the references to the writings of Fischer Hinnen and Drs. Arnold and Mir and others are useful.

The question of windings is treated rather fully, and with several good diagrams and tables. In connection with multiple windings, the author writes:—"Triple windings have also been used with success, but this appears to form the practical limit to their employment. . . . . The difficulty is to keep the thick brushes bearing over the requisite number of segments. . . . . As the surface of the brush slowly wears away . . . . the slight circular rotation of the holders causes the brush to bear on its toe and its heel to move out of contact." Although the author does not mention it, separate carbons sliding in a box and pressed down by spring fingers get over the difficulty, but have the objection of making an objectionable screeching, clattering noise.

Later on, when dealing with carbon brushes, he mentions that:—"It is owing, in part, to the contact resistance being so much—nearly 13 times—greater than that with copper, that brushes of this material are now so generally employed. Nevertheless, as the maximum current density permissible with carbon is only about one-fifth of that with copper, a larger surface is necessary, leaving the advantage in this respect of carbon over copper as about three to one. A further point in favour of carbon is, that nothing in the nature of fusion with the commutator can occur, even when sparking does take place."

When dealing with the question of commutation, the author gives a quantity based on the contact resistance between brushes and a single segment; the total time of short-circuiting; and the coefficient of self-induction of the circuit. This quantity, he says, must be greater than unity if collection is to proceed sparklessly.

If, by reason of high self-inductance, high speed, or the brush contact resistance being low, this condition is not complied with, then the current density at the end of short circuit is excessive, the commutator and brush are heated, and sparks are produced.

Increasing the total resistance of the short-circuited coil, as is sometimes done by making the commutator uprights or risers of high resistance metal, is seldom beneficial, and may often be disadvantageous. The difference in action between the two resistances is due to the contact resistance varying proportionately to time, while that of the uprights or risers remains constant.

Quite a large section of the book is taken up with the consideration of motors for traction and for driving machinery. The difference between cumulative and differential compound winding is explained, the former giving a good initial starting torque and the latter a very uniform speed, as is required, for example, when driving textile machines.

The book finishes with two well-written chapters on "Characteristic Curves" and on "Testing."

Chaudières Marines. Par M. L. E. Bertin. Second Edition. Paris: E. Bernard & Cie. 1902.

M. Bertin is the chief engineer of the French Navy, and writes with that nicety of expression which characterises many of the French technical works. The present edition has been very considerably enlarged upon the last, which alone has been translated.

M. Bertin deals with the principles of marine boilers from the point of speed, regularity and radius of action. Most of the engineers and others who have talked so much of the light weight of water-tube boilers have forgotten two essential facts. First, that water-tube boilers and their supplementals do not appear to possess the quality of lightness claimed for them; and second, that when boilers fall in evaporative efficiency, or lose much feed water by leakage, they are deprived of the supreme advantage of long radius of action. A boiler good enough for home service may consume far too much coal on a long voyage, and a poor boiler, however light in weight, is more than counterweighted by the large amount of coal that must be carried to help out its inefficiency. Water-tube boilers are legion. In this book they appear in many guises, and it is worth noting that of the whole lot only one studies the true principles of combustion in its furnace arrangements so fully as should be done. This is the Weir boiler of Cathcart, in which the furnace is completely lined with firebrick, and so, also, is the combustion chamber. The French Doyere boiler goes part way in the same direction. M. Bertin specially refers to the Weir boiler, however, and recognises its merits.

So far as appears at present, the most satisfactory small tube boilers are those which embody the general form of construction followed by Weir, Thornycroft, Yarrow, and some other makers.

One can hardly understand how the Ward boiler of the U.S. S. *Monterey* can have developed such qualities as to lead Admiral Melville to adopt water-tube boilers. M. Bertin significantly states that the Admiral nevertheless adopted a very different type from the Ward when he did adopt water-tube boilers.

In the present edition there is a chapter on engines, but this is very limited, boilers forming the mainstay of the book. A very excellent chapter on coal fuel and its calorific value will be found. The author adopts M. Gruner's general classification of coals—a classification which follows not merely geological sequence, but density from lignite to anthracite. He adopts as the calculated calorific value of coal the formula

$$Q = 8{,}140\ C + 34{,}500\ H - 3{,}000\ (100 - C - H), \text{ or}$$
$$Q = 11{,}140\ C + 37{,}500\ H - 300{,}000.$$

The details of grates are referred to; draught, natural and forced, is treated of pretty fully, as is also feed heating, air heating, &c. A chapter is given on firing, and mechanical stoking.

The chief extension of this second edition is, however, in the department of liquid fuel, which is treated chemically, physically and mechanically, and numerous figures and tables are added with particulars of calorific power of different petroleums, which, we may say, show that all of them are very much alike.

The various means and methods of employing liquid fuel are somewhat copiously illustrated from Nobel's, and the earlier tray system of St. Claire Deville, to the present day atomiser, which seems likely to become standard in principle. Very many atomisers are illustrated, both English and American, as well as French and Russian. A few boilers are illustrated to which liquid fuel has been applied.

The author seems to have modified his views in regard to the atomising agent, and to be more favourable to steam than he once was. He rather inclines to the view that steam really does help to secure a better calorific effect from fuel, not, of course, because the steam serves in any way as a combustible—M. Bertin is too sound an engineer to favour this heresy—but because it probably acts in some way to promote combustion. Indeed, did not Prof. Dixon state that hydrocarbons could only burn in the presence of water vapour? If such be the case, one would think that air could still be used as the atomising agent, and a little water could be fed in with it to give the necessary effect. However, M. Bertin does not uphold his former views.

In regard to the use of coal and petroleum together, the author points out that the excess of air admitted through the grate serves well to burn the oil sprayed in above, and he is quite prepared to think it good under suitable conditions.

All who can read M. Bertin in the original will find his work of great value in helping them to a conclusion on the water-tube question. Accessories are also dealt with, including superheaters and self-regulating feed apparatus.

We note, also, additions since the last issue among the boilers, the Weir and the Solignac being both illustrated. It is remarkable how little attention almost all the water-tube boiler makers pay to the perfection of combustion. Most of the boilers illustrated would be very smoky, yet the Weir boiler is a living proof that combustion may easily be made perfect, and M. Bertin recognises this and appreciates the reason for it.

Lucknow Tramways.—*The Friend of India* reports that an application has been made by Messrs. Crompton & Co., London, to the Provincial Government for permission to supply Lucknow with electric traction. If sanction is given the Municipality will probably introduce a system of electric lighting.

BUSINESS NOTES.

Electrical Wares Exported.

Week ending July 15th, 1902.		Week ending July 14th, 1903.	
Alexandria	Value £392	Alexandria	Value £109
Azores	200	Auckland	103
,, Teleg. instruments ..	190	Beira	41
Boulogne	15	Bombay	86
Buenos Ayres. Teleg. mat. ..	138	Bordeaux	65
,, Teleg. wire ..	611	Boulogne	39
Calcutta	391	Buenos Ayres. Teleph. mat. ..	593
Cape Town	831	Calcutta	2,597
,, Teleg. mat.	317	,, Teleg. mat.	230
Channel Islands	63	Cape Town	1,063
Christchurch	61	,, Teleg. mat. ..	1,096
Colombo	396	Channel Islands	32
Durban	820	Colombo	440
,, Teleg. mat.	132	,, Teleg. mat.	90
East London	1,282	Delagoa Bay	239
Gibraltar	50	Durban	507
Gothenburg. Telephones ..	444	East London	903
Hamburg. Teleg. mat.	591	Flushing	20
Hong Kong	10	Fremantle	56
Melbourne	113	Hong Kong	2,732
New York	140	La Plata	50
Port Elizabeth	33	Madras	261
St. Petersburg. Teleg. wire ..	1,162	,, Teleg. mat.	33
Shanghai	47	Malta	12
Singapore. Teleg. mat. ..	209	Melbourne	833
Stockholm. Teleph. cable ..	455	,, Teleg. mat.	650
Sydney	1,274	Monte Video. Teleg. cable ..	190
		North Atlantic. Teleg. cable ..	4,000
		Otago	248
		Paris	197
		Penang	965
		Port Elizabeth	45
		,, Teleg. mat. ..	74
		Rangoon	50
		Rio Janeiro	160
		Rotterdam	80
		Rouen	24
		Shanghai	264
		Singapore. Teleg. mat. ..	98
		Stockholm. Teleg. cables ..	178
		Sydney	1,560
		,, Teleg. mat.	482
		Wellington. Elec. cable. ..	3,580
Total ..	£10,297	Total ..	£24,595

Foreign Goods Transhipped.

Gothenburg. Telephones	Value £55
Labrador. Elec. mat.	24
New York. Elec. mat.	90
Otago. Elec. mat.	25
Total	£194

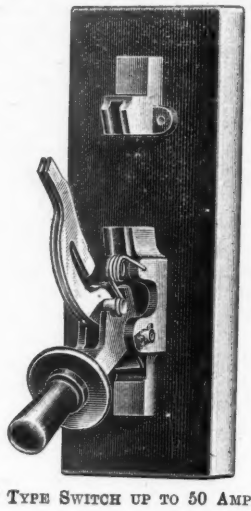
Glow Lamp Tests.—We have received a copy of a report relating to tests carried out by the Electrical Standardising, Testing and Training Institution, on twelve carbon glow lamps made by the United Electrical Co., Ltd., of Ujpest, near Budapesth. The lamps were tested on an ordinary A.C. circuit at 216 volts, against a Hefner standard lamp, and the results are given in terms of the Hefner unit, which is about ·88 of a British candle. The tests were carried on in each case until the candle-power had fallen 25 per cent., and all the lamps lasted over 700 hours before reaching this limit, while two of them attained 1,200 hours. Only two lamps broke down, at 710 and 983 hours respectively; excluding the latter, the average useful life, so defined, was over 900 hours. The average starting candle-power was 14·80 Hefner units, or 13 C.P., and the mean candle-power during 700 hours was also about 13 C.P. The inefficiency at starting was 4·05 watts per C.P., and after 700 hours, 4·58 watts per C.P., in British units, the mean being 4·13.

We regret to see that the Electrical Standardising, &c., Institution states its results in Hefner units, as these are very misleading to English readers. It is also unfortunate that in the statement of average results, for which the makers of the lamps are, no doubt, responsible, the increase in the inefficiency of the lamps of 13·2 per cent. after 700 hours, is referred to as "Increase of the efficiency after 700 hours," a contradiction in terms which is presumably traceable to the loose manner in which the word "efficiency" is commonly used. The life curve of the lamps rises about 2 C.P. during the first 100 hours, after which it falls uniformly up to the end of the test.

The "Veritas" Athletic Club.—The employés of Messrs. Falk, Stadelmann & Co., of Farringdon Road, have formed the "Veritas" Athletic Club, about 70 members of the staff being already enrolled. On June 6th the club went for a 20-mile walking match. The best record was that of A. Mortimer, jun., who covered the distance in 3 hours 29 minutes. There were six other winners of prizes (one being the "Veteran's"), and 15 other competitors who covered the distance with the 4 hours' limit received silver medals. There were some 1,000 employés present to witness the event. The prizes were distributed at the club's first annual Bohemian smoking concert, held on June 19th at the Holborn Restaurant, under the presidency of Mr. Max Falk; 500 employés were present. The expenses of the concert were entirely defrayed by the directors of Falk, Stadelmann & Co., who also subscribed 10 guineas towards the prizes and inauguration of the club.

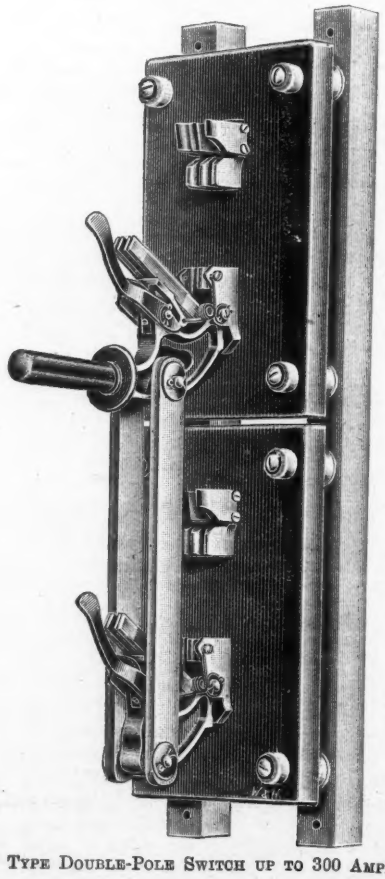
Messrs. Siemens's New Works.—A Birmingham paper says that the extensive buildings, covering several acres of land, which Siemens Bros. & Co. are erecting at Stafford, are rapidly nearing completion, and their employés are being gradually transferred to the town. It is expected that in six months' time the population of Stafford will have been permanently augmented to the extent of two or three thousand people.

An Improved Chopper Switch.—Messrs. Dorman and Smith, of Ordsal Electrical Works, Salford, have introduced a new series of main switches of the edgewise or chopper type, which they are manufacturing extensively. The series has been designed for universal requirements up to 600 volts, and they are now being almost exclusively used on the well-known switchboards made by this firm. We illustrate two of the series, all of which make and



"C" Type Switch up to 50 Amperes.

break contact from the top and bottom jaws simultaneously. In the case of the switches for 100 amperes and upwards, the blades are tilted by an ingenious arrangement in operating the handle in opening or closing the circuit, to secure the principle of simultaneous break without making the top jaw stand out a long way from the



"C" Type Double-Pole Switch up to 300 Amperes.

base. The small sizes, of 15, 25 and 50 amperes capacity, are arranged with independent handles and quick-break blades. The intermediate sizes of 100, 200 and 300 amperes, of which we illustrate a double-pole example, are arranged with auxiliary arc-breaking contacts of special design. A pair of massive carbon blocks are attached to the top contact jaw, and engage with a copper flicker hinged to the handle casting, the final break taking place between this copper and carbon device.

The special advantage of this arrangement is that, for circuits not having much inductance, such as lighting circuits, the flicker affords an efficient quick-breaking device. At the same time, the flicker does not afford a long range of quick fly, but only covers a portion of the total movement of the handle and blades, so that, in the case of a circuit with excessive inductance, such as a motor circuit, where the arc would be of great length if suddenly ruptured, the slower movement of the flicker during the latter portion of its motion on opening the switch, results in a safer and more reliable rupture of the circuit being made than would be possible with an entirely quick-break switch.

Switches for 500 amperes and upwards are constructed with a massive auxiliary carbon device to finally take the arc on rupturing the circuit. In the case of switches of this size, which are mostly used for main generators, it has been found more desirable to provide a safe and easily renewable auxiliary arc-rupturing contact than to have the disadvantages of percussion, or of light construction necessary for an independent quick-breaking switch. The switches are, therefore, massive, have a long break, and the final break takes place between large renewable carbon blocks—a method of construction which allows a generator circuit to be opened with safety and without risk of damage to insulation.

Bankruptcy Proceedings.—An application for an order of discharge was made last Friday to Mr. Registrar Brougham at the London Bankruptcy Court on behalf of Edward Baldwin Pym, electrical engineer, late of Bar Chambers, Scarborough, and now of Branham Gardens, South Kensington. Mr. E. S Grey, Official Receiver, reported that the debtor failed in November, 1898, with liabilities amounting to £3,744 14s. 5d; the assets had realised £115 0s. 8d, and a first and final dividend of 4½d. in the £ was paid to the creditors. From 1881 to 1892 the debtor was engaged in sheep-farming in Australia; but returning to England in the latter year, he commenced business in July, 1893, as an electrical engineer at Bar Chambers, with a capital of less than £100, and some technical training. In order to carry on the business he borrowed £1,800 from a relative, who was subsequent adjudged bankrupt in consequence of the debtor's failure to repay any part of the loan. The trading by the debtor was unsuccessful, and in 1896, upon an execution being levied on the premises, he abandoned the business and removed to London. Of the present liabilities about £2,000 related to the Scarborough business. The debtor had since been without occupation; but on April 4th, 1897, he became entitled under the will of an uncle to a life interest in £10,000, alienable on bankruptcy. The income produced by the investment of that sum was £218 a year, and was now payable to the debtor's daughter. The failure was attributed by the debtor to loss on the electrical business, to excess of expenditure over income, and to liability on bills accepted chiefly for the accommodation of other persons. In May, 1898, the debtor, when hopelessly insolvent, accepted two bills of £350 and £300 respectively for the accommodation of a financial agent who paid him £50 for the use of his name. Those bills were dishonoured, and had never been met. The offences alleged by the Official Receiver were:—(1) Insufficiency of assets to pay 10s. in the £ to the unsecured creditors; (2) imperfect books; (3) trading with knowledge of insolvency; and (4) contracting debts provable in bankruptcy without having at the time reasonable or probable ground of expectation of being able to pay them. Without calling upon Mr. Muir Mackenzie to address the Court in support of the application, the learned Registrar said he did not propose to go beyond the minimum term of two years' suspension, having regard to the length of time that had elapsed since the failure. Order for a further suspension of two years was entered accordingly.

Dissolutions and Liquidations.—A receiver and manager has been appointed in an action brought by a debenture-holder against O. Berend & Co., Ltd., of Dunedin House, Basinghall Avenue, E.C. The loss of two valuable agencies having reduced the turnover and profits, is said to have greatly conduced to the present position of affairs. A rough statement shows that the position at June 30th last was to leave a deficiency to the ordinary creditors of 10s. in the £ approximately, but this, of course, largely depends upon the successful realisation of the assets of the company. A meeting of shareholders was to be held on Tuesday, with a view to passing resolutions for voluntary liquidation.

A meeting of the Doe Portable Electric Light and Power Syndicate is to be held at Birmingham on August 18th to hear an account of the winding-up from Mr. G. H. Tyler, liquidator.

Mr. E. Stiff has retired from the firm of J. Stiff & Sons, of London Pottery, Lambeth. As ill-health had prevented that gentleman from taking any part in the conduct of the business for some years past, no difference in methods or management will result from his retirement.

Messrs. W. J. Nunn, F. H. Watts, and T. R. B. Nunn (Nunn, Watts & Co., electrical, gas, &c., engineers, 82, Mark Lane, E.C.) have dissolved partnership. Messrs. Watts and T. R. B. Nunn will attend to debts.

Exports of Electrical Machinery.—The value of the British electrical machinery exported during June last is returned at £37,776, as compared with £38,799 in the preceding month, and bringing the total for the first half of the year up to £224,124.

Switzerland.—Messrs. Brown, Boveri & Co., of Baden, are declaring a dividend of 7 per cent. for last year.

Annual Excursion.—On Saturday last the employés of the Hart Accumulator Co., Ltd., went for their Annual Excursion. A very enjoyable day was spent at Hastings, and we are informed that "the party returned to town in the evening."

Catalogues and Lists.—The AMERICAN ELECTRICAL NOVELTY AND MANUFACTURING CO., LTD., of Charing Cross Road, W.C., have issued a neat pocket price list of "Ever Ready" electric lamps for watch-stand, alarm clock and other lights.

MESSRS. J. C. LYELL & CO., of Victoria Street, S.W., have issued a new catalogue of the "Hythe Automaton" steam and electric pumps. The latter include electric pumps for hydraulic and mining service.

FROM MR. AUGUST REICHWALD, of Finsbury Pavement House, E.C., we have received three crane catalogues. They show (1) wharf cranes; (2) locomotive revolving steam cranes; and (3) electric overhead travelling cranes (three motor) made by Messrs. Bechem and Keetman, of Duisburg-on-the-Rhine, for which firm Mr. Reichwald is sole agent in this country.

MR. RUPERT H. WAITE, of 78, Queen Victoria Street, South Bank, York, has sent us a small waistcoat pocket "Electrical Engineers' Reference Table," of which we understand 20,000 copies are being given away. It is a handy little card for wiremen and contractors' representatives, showing the sizes and current-carrying capacities of different wires.

MR. PETER BROTHERHOOD, of Belvedere Road, S.E, whose name is familiar to everyone as the maker of high-speed steam engines, has issued a new list of such engines for dynamo driving.

MESSRS. HOLDEN & BROOKE, LTD., have just issued a number of new lists. No. 45 describes Brooke's Patent Water Separator or Steam Dryer. This apparatus is made all steel, without rivets, and forms a suitable dryer for high pressures. No. 46 describes Brooke's Patent Oil Separators; No. 47, Brooke's Patent Automatic Grease Discharger or Vacuum Trap. Another pamphlet deals with the firm's "S" pattern One Movement Injector, for feeding any class of boiler at any pressure up to 300 lbs. per sq. in. Still a further pamphlet describes Brooke's Patent Split Cone injector, which is especially designed to deal with bad feed water; this pamphlet also illustrates their Motor-Car Injector. The lists are all carefully arranged and well illustrated.

Ships' Light Indicators.—Messrs. W. McGeoch & Co., Ltd., of Glasgow, have issued a circular describing their new Duplex patent ships' light indicator, which has been specially designed for use with twin filament lamps as recommended by the Board of Trade for ships' signal purposes. The chief feature of the indicator is that it not only gives warning when a lamp is extinguished but also indicates when one filament of a twin filament lamp has burnt out. There is thus no necessity for having the lamp changed at once; fortunately this is so because it is usually very inconvenient to change during the night. On the front of the containing case there are arranged a series of "windows" representing the various signal lamps of the ship, and in addition a small green window is fitted at the top of the case to show when the "pilot" lamp which is used to illuminate the windows is alight. When all the signal lamps are burning properly the windows representing signal lamps are screened by shutters and no light appears except from the small pilot window. Should one filament of a lamp burn out, the window representing that lamp half uncovers and shows a half-red light. Should a lamp go totally out, the corresponding window shows an all-red light and a bell in connection with the indicator commences to ring and continues doing so until switched off by the switch controlling the faulty lamp.

Books Received.—"The Alternating Current Transformer," by F. G. Baum. New York: McGraw Publishing Co., 114, Liberty Street. 1903.

"The All Red Line: The Annals and Aims of the Pacific Cable Project," by George Johnson. London: Edward Stanford. Ottawa: James Hope & Sons. 1903. Price 6s. net.

Science Abstracts. No. 66. June, 1903. London: Feilden Publishing Co. Price 1s. 6d., each part.

Journal of the Institution of Electrical Engineers, Vol. 32 (*Part* 4), by W. G. McMillan. London: E. & F. N. Spon, Ltd., 125, Strand. Price 5s.

"Regulations for Evening Schools, Technical Institutions, and Schools of Art and Art Classes;" Board of Education. London: Eyre & Spottiswoode. 2d.

"Secondary Batteries: A practical hand-book for owners and attendants," by "An Engineer." London: H. Alabaster, Gatehouse & Co., 4, Ludgate Hill. 4s.

Trade Announcements.—Messrs. C. E. and H. M. Peel, Ltd., engineers, &c., of Swansea, have found it necessary, owing to the increased business in their mechanical and electrical departments, to form a separate company therefor, under the title of the Glamorgan Engineering Co., Ltd. Messrs. C. E. & H. M. Peel will retain their interest and remain as directors, and Mr. A. L. Furneaux (late of Messrs. Crompton & Co., Ltd., of Chelmsford) becomes a director, and will act as manager of the electrical department. Mr. C. W. Jordan will continue to act as general manager of the Glamorgan Co. Mr. Smart will also continue chief engineer. The present shop at Upper Strand Works having become insufficient, new works on up-to-date lines are to be erected on adjacent land.

Messrs. J. E. & S. H. Thompson notify that they have severed their connection with Lord & Shand, Ltd., and have opened showrooms and offices at 44, Old Town Street. Plymouth, where they will carry on business as Thompson Bros. & Co. Their tender for the installation of the equivalent of 120 8-c.p. lamps at Messrs. Heath and Stoneman's premises at Plymouth has been accepted.

We understand that, owing to the rapid increase of their business, Messrs. Geipel & Lange are removing to new and more commodious premises at 72A, St. Thomas Street, S.E., where they have also obtained a large warehouse for the purpose of increasing their stock of electrical apparatus.

American Street Railways.—We have received a copy of the tenth annual issue of "American Street Railway Investments," which is published by the McGraw Publishing Co., of New York. It contains reports of 1,361 American companies, showing in detail the financial and physical condition of the properties. 1,300 of these reports are of an official character, the information being furnished by the railroad companies themselves. These figures include both operating and leased roads, and include data of all new roads. The reports of companies are this year arranged by States, instead of alphabetically by towns as heretofore. There are given about 25 folding maps of the most important street railway systems in the United States, also a table showing by comparisons the gross receipts of all companies earning $25,000 or more for the years 1901 and 1902.

Sites for New Works.—About 40 acres of ground specially suitable for public works is offered by the Corporation of Perth.

National Electrical Contractors' Association.—Successful meetings of the Northern Section of the National Electrical Contractors' Association were held at the Grand Hotel, Manchester, on Saturday, July 4th. Members were present from all parts of the North of England, and many important matters, including registration and training of workmen, municipal trading, &c., were discussed. It was reported that good work was being done by all the local associations, and that many new members had joined. Electrical contractors in the North of England wishing to become members should write to the hon. secretary, Mr. W. Cross, 4, St. Nicholas Buildings, Newcastle, who will be glad to give them any information.

Battery Contracts.—The sub-contract for the storage battery for Devonport has been placed by the British Westinghouse Co. with the Electrical Power Storage Co., and the sub-contract for the storage battery for Gibraltar has been placed by the Electrical Construction Co., Ltd., with the same company. The E.P.S. Co. has also booked the contract for storage battery for the Kettering U.D.C.

Tramway Contracts.—Messrs. J. G. White & Co., Ltd., have obtained the following contracts since the end of June:—Derby Corporation Tramways: complete construction, permanent way, overhead equipment, cables, cars and equipment, £87,627; Colchester Corporation Tramways: complete construction, permanent way, overhead equipment and cables, £35,039; Rochdale Corporation Tramways: overhead equipments, £21,620; Gloucester Corporation Tramways: supply of poles and mountings, £4,381.

Manchester Exhibition, 1905.—An International Exhibition is to be held in Manchester in 1905, and a preliminary working committee has been appointed to ascertain the views of those likely to be interested in the project. Later the replies obtained will be laid before the Lord Mayor of Manchester, with a request to call a town's meeting to consider the matter. The scope of the Exhibition is to comprise all that is best in industries, arts and sciences, home, colonial and foreign. Since the last Exhibition (in 1887) the population and wealth of Manchester and district have gone ahead by leaps and bounds, and the immense strides in mechanical and electrical inventions have been remarkable—therefore it is considered that the time is ripe for another and even more successful Exhibition. Mr. Wm. King, of 27, Brazennose Street, Manchester, is the hon. secretary. The chairman of the preliminary Committee is Mr. G. P. Dawson, of Beyer, Peacock & Co., and Dr. W. G. Rhodes is among the members.

For Sale.—Messrs. Fuller, Horsey, Sons & Cassell will on July 29th offer for sale by auction the electrical copper depositing works, electric generating and depositing plant, at Widnes, Lancs. They will, on July 30th, offer for sale in London, some leasehold manufacturing premises, plant and machinery, also stock of electrical and other fittings at Hatton Garden.

On Friday, July 24th, Messrs. Norman & Son will sell certain electrical plant and fittings by auction at Stratford, E. Some further particulars are given among our advertisements to-day.

Messrs. Wheatley Kirk, Price & Co. are offering various modern electric lighting plant for sale.

Reavell's Compressors.—Messrs. Reavell & Co., of Ipswich, report further orders for their new type of motor-driven air compressors. The latest order is from the Crown Agents for the Colonies, for three machines of 75 H.P. each, for work on the Central South African Railways. The machines are to be similar to that exhibited at the Colliery Exhibition at the beginning of this month, but of larger size.

Annual Holidays.—Messrs. Crompton & Co., Ltd., will close their Arc Works, Chelmsford, from August 1st to 10th for the annual holidays.

The works of Messrs. D. Bruce Peebles & Co. will be closed from July 18th to 27th for the annual trades holidays.

ELECTRIC LIGHT AND POWER NOTES.

Arbroath.—The T.C. has decided to hand over the lighting of the burgh with electricity to a company in preference to carrying out the undertaking itself.

Brentwood.—The U.D.C. has decided to invite terms from certain companies which have applied for permission to introduce the electric light.

Barnstaple.—A L.G.B. inquiry has been held into the application of the T.C. to borrow £2,500 for purchasing the town mills and contingent water rights. A portion of the water is intended to be used for condensing purposes at the electricity works. There was some opposition.

Buenos Ayres.—It is stated that the undertaking of the Primitiva Gas and Electric Lighting Co. is about to be taken over by the German Transmarine Electricity Co., represented by the A.E.G., at a purchase price of £600,000; the reports, however, are somewhat conflicting. The German Co., which carries on a large electric lighting business at Buenos Ayres, recently absorbed a French electric lighting company in that town.

Burslem.—A scheme for lighting the town by electricity has been provisionally adopted by the T.C. The cost, it is stated, will be about £20,000. It has been decided to withdraw all opposition to the North-Western Electricity and Power Gas Bill.

Caerphilly.—The U.D.C. intends to obtain expert advice upon the public lighting of the district.

Chippenham.—The T.C. has received from the Southern District Electricity Corporation notice of its intention to apply to the B. of T. for a prov. order to supply electricity within the borough.

The T.C. has given notice to the R.D.C. of its intention to apply for powers to supply electricity to the districts contiguous to the borough.

Clydebank.—The T.C. has, by a majority of one, decided to carry out its own electric lighting prov. order, instead of handing it over to the Clyde Valley Electric Co. The cost of the scheme which the Council is now committed to is about £35,000, exclusive of the site, which already belongs to the burgh.

Crewe.—The electrical engineer has been instructed to prepare an estimate of the cost of lighting the principal streets by means of arc lamps.

Croydon.—The Corporation is at present considering a scheme laid before it by the borough electrical engineer (Mr. J. Gray Scott) for alterations and additions to the electricity works, at a cost of £70,000, to meet the increasing demand for energy for lighting and power purposes. This amount is made up as follows:—Engine room and boiler house extensions, including stanchions to carry coal bunkers and overhead crane, £15,000; six boilers, each capable of evaporating 12,000 lbs. of water per hour, £8,400; foundations and flues in connection therewith, £2,400; filtration plant for hot well water, including erection, £450; two feed pumps for boilers, £350; economiser, £1,200; coal conveyor, plant and bunkers, £3,600; two 1,000-H.P. generating sets for alternating current, £14,000; one 1,000-H.P. generating set for continuous current, £7,000; foundations in connection with the above, and also for condensing plant, £1,350; condensing plant, including new cooling tower, £3,500; one engine for No. 2 generator, £700; switchboard extensions, switch gear, instruments and cables, £500; pipe work, steam, exhaust and drain pipes, £1,500; one 100-KW. 5,000-volt transformer, with switchboard, cables, &c., £350; railway siding, £4,200; contingencies 10 per cent., £6,450; total, £70,950.

Some short time ago the Corporation decided to defend an action brought against that body by the owners of premises adjoining the electricity works, in respect of injury and annoyance caused by the spray from the cooling pond, but the negotiations that have gone on between the parties have resulted in a settlement of the case. The Corporation has paid the agreed costs, and given an undertaking that after August 16th, no spraying from the pond or cooling towers shall take place into the plaintiffs' premises.

Dublin.—On Wednesday last the Corporation was to take over the new electrical installation from the contractors, though the staff to take charge of the plant had not been appointed.

Dursley.—Two companies have notified the R.D.C. of their intention to apply for prov. orders, the Gloucestershire Electric Power Syndicate for Dursley alone, and the Western Electric Power Co. for the whole of the Council's district.

East Barnet.—The North Metropolitan Electrical Power Distribution Co. and the Empire Electric Light and Power Co. have given notice of intention to apply for prov. orders.

Edinburgh.—The E.L. Committee has agreed to recommend that the charge for energy for each public lamp should be reduced from £13 to £12 10s. per annum.

Eton.—Five months ago the U.D.C. decided to experiment with electricity at the sewage disposal works in place of steam. Reporting on the cost, Mr. E. Bailey Denton states that 8,863 units have been consumed, and that the Windsor Electrical Installation Co. proposed, if electricity was employed, to charge 3d. per unit for the first 6,000 units, and 1½d. beyond, making with a total of 16,000 units per annum, a cost of £137 10s. a year. Mr. Denton advises the Council to accept this proposal. A committee is considering the matter.

Farnham.—The U.D.C. has appointed a special committee to consider offers from the Sir Hiram Maxim Electrical and Engineering Co., the Inland Waterways Co. and the National Electrical Wiring Co. to work the Council's provisional order.

Hampton Wick.—The Twickenham and Teddington Electric Supply Co., Ltd., has notified its intention to apply to the B. of T. for a prov. order for electric lighting in the district.

Hanwell.—The Southall Electric Supply Corporation and the Empire Electric Power Co. have given notice of intention to apply for a provisional order. The D.C. has decided to oppose the application, and has appointed a committee to consider the advisability of the local authority seeking power itself.

Hereford.—The electricity accounts show a gross revenue for the year of £2,312, working expenses £997, and interest on capital £642, leaving a surplus of £673 towards repayment of capital, which requires a sum of £920.

Hollingbourne.—The Kent Electric Power Co. have informed the R.D.C. that they intend to apply to the B. of T. for a prov. order to supply electricity within the whole of the Council's area. The Council on July 9th decided to oppose the application.

Hove.—At the meeting of the T.C. on July 9th notice was received from the Hove Electric Lighting Co., Ltd., of their intention to apply for a prov. order to supply electricity to Aldringham. Five years ago the T.C. obtained a similar order, and the last extension of time, which the B. of T. states is final, expires on Feb. 14th next. With a view of avoiding the risk of the Order lapsing for want of action, the General Purposes Committee recommended the T.C. to apply to the L.G.B. for a loan of £15,000 for the scheme, and this recommendation was adopted on July 9th.

Italy.—Application has been made for a concession to put down a plant to utilise the water-power of the River Esino in the generation of electrical energy, and to transmit the same to Ancona for power purposes. It is estimated that 1,800 H.P. will be available.

Kingstown.—The E.L. Committee is considering proposals made by Mr. W. M. Murphy on behalf of the Dublin United Tramways Co., to supply electricity to the Urban District for public and private lighting, or to form a company to undertake the lighting of the township.

Leyton.—The annual report of the Lighting Committee of the U.D.C. shows a capital expenditure of £126,455, a revenue from sale of energy of £15,084, and a net profit of £925. It is stated that the existing plant could supply double the amount of power applied for up to the present.

Lichfield.—At a recent meeting of the City Council a resolution was adopted appointing an independent solicitor for the promotion of the supplemental electrical prov. order. It was explained that the gas company had announced its intention of opposing the application, and the town clerk was both a director and the solicitor to the gas company.

London.—MARYLEBONE.—On Monday evening, at a special meeting of the M.B.C., a settlement was arrived at regarding matters in dispute with the Metropolitan Electric Supply Co., which Mr. Justice Buckley, in recently giving judgment for specific performance, referred for decision to Mr. C. A. Russell, the umpire in the arbitration.

The terms of settlement, as recommended for acceptance by Mr. Moulton, K.C., and Mr. Cane (counsel for the Council) and Mr. A. Wright (the Council's consulting engineer) were as follows:—(1) The undertaking to be taken over and money paid on December 31st, 1903 (subject to power to apply to Court). (2) The capital expended by the company between January 1st, 1902, and June 30th, 1903, agreed at £67,250, to be paid on December 31st, 1903 (subject as above). (3) The amount of £5,000 to which the company are committed to be repaid, if expended, on that date without interest. (4) Profits to be set off against interest on amount awarded until payment of purchase money. (5) Expenditure to be made for future developments as Council approve, and to be repaid with interest at 4 per cent. on December 31st, 1903 (subject as above). (6) Company to take back motor-generators on July 1st, 1906, at £15,000, Borough Council keeping them in good order in the meantime. (7) The Council to repay to the company the cost of severing the Marylebone portion of the Norfolk Crescent and St. John's Wood districts, when the Council cease to take their supply for those districts from them. The above terms to be embodied in the Order in the action with costs. Objections to breaking up streets for North Street mains to be withdrawn.

Several members referred to the manner in which the business had been muddled, and the way in which they had been outwitted by the company on every point.

Sir Thos. Brooke Hitchens said the Committee and Council, by their mismanagement, had done much to bring municipal trading into discredit, and in this way, although the ratepayers would have to suffer, a valuable service had been rendered to the county. He himself, as a plain business man, could never understand why the fact had not been put forward in the arbitration that the company had offered to accept for the undertaking £400,000 less than the sum which was finally awarded. The best municipal committee they could get could not compete with a board of expert directors, and he, therefore, asked the Council, even now at the eleventh hour, to try to arrange with the company to retain the undertaking.

Dr. W. Leaf stated that the company would not consider terms to let the Council off paying the amount fixed by the arbitration. This agreement would, however, end litigation between them.

Mr. E. R. Debenham, Chairman of the Committee, said that according to the terms of the arbitration all that had to be done was to find out the actual cost of the work, the original estimates for which were £92,093. So far as he could see there was an end to all disputes, as all further expenditure by the company could only be made with the Council's consent. Of course, if the Council could not get the money by December they would have to ask for further relief.

The following resolution was adopted *nem. con.*: "That the Committee be authorised to enter into an agreement with the company on the basis of the suggested terms of settlement, and that the Committee be instructed to require the company to prove that their expenditure down to June 30th has been as stated."

STEPNEY.—The M.B.C. last week resolved to ask the local members to oppose the provisions in the Supply of Electricity Bill with reference to bulk supplies.

As a note which we recently published in regard to street lighting matters in this borough is somewhat misleading, it is worth noting that the petition recently presented concerned two streets in which 13 ordinary converted gas columns were in use, each having two 16-C.P. electric incandescent lamps, and not arc lamps as specified. It was suggested that these should be replaced by 50-C.P. Welsbach gas mantles; and the Council has decided to try some Nernst lamps. It is due to Mr. Tapper, the borough electrical engineer, to add that the arc lighting in the main thoroughfares in this district is equal to any in the metropolis.

HACKNEY.—The Borough Council has decided to reduce the price charged for electrical energy for power purposes from the flat rate of 2d. per unit to the following:—For the first 1,000 units per quarter, 2d. per unit; all consumption in excess of 1,000 units per quarter, 1½d. per unit.

BATTERSEA.—It was resolved by the M.B.C. last week to petition against the Supply of Electricity Bill. Upon the suggestion of the electrical engineer, electric mains near eight bakers' premises are to be relaid further away, at an estimated cost of £155. An alternative scheme, prepared by the borough surveyor and borough engineer, for providing plant for raising coal from barges and conveying it to the central generating station, was approved by the Finance Committee. The estimated cost is £2,662, as against £3,500 for the original scheme.

SOUTHWARK.—The M.B.C. last week authorised the electrical engineer, with a view to increase the demand for energy for power, to enter into an agreement with the British Thomson-Houston Co., Ltd., to act as their agent for the sale of motors on the hire-purchase system, all monies received as commission to be paid to the electric lighting account, and the company to be permitted to deposit at their own risk, a number of motors at the electric light station, on sale or return.

ST. PANCRAS.—According to the statement of accounts of the electricity undertaking of the M.B.C., the gross revenue for the past year was £68,372, and the net revenue £32,275; after meeting capital charges there was with £1,334 brought forward a surplus of £18,152. The Committee recommended that after certain deductions £15,000 should be placed to reserve, and £530 carried forward; but the Council decided that £7,200 should be applied to the relief of the rates.

Maidenhead.—In connection with the electric lighting plant the three steam dynamos were installed by the Industrial Engineering Co., of Newton, near Hyde, who took over the work from the Clayton Engineering Co., to whom the order was entrusted.

Montrose.—The Harbour Committee is considering the lighting of the harbour by electricity and the working of the gates by motors.

Motherwell.—The annual report by the burgh electrical engineer, which was submitted at a meeting of the Town Council held on 7th inst., showed that the number of consumers had increased during the year by 82 per cent. The number of units sold was 291,247, an increase of 124,387. The lighting had increased 48 per cent., power 830 per cent. and public lighting 13 per cent. The total cost of producing the energy sold was 13 per cent. lower than last year, and the revenue showed an increase of 41 per cent. There was a net profit on the year of £166 17s. 11d. The Council resolved to reduce the charge for energy to 3½d. per unit for lighting, and to 1½d. as the maximum and 1d. as the minimum for large consumers of power, according to the quantity taken. The rate for small consumers of power remains as before at 2d. per unit.

New Malden.—The U.D.C. has resolved to apply to the B. of T. for a prov. order for electric lighting.

Newcastle (N.S.W.).—The City Council is going to double its electric lighting plant at a cost of £4,450.

Northallerton.—The U.D.C. has accepted the tender of the Electric Lighting Company to light the town with arc lamps at 15s. for 100 hours, with incandescent lamps at 3s. per 100 hours, and in side streets at 3s. 9d.

Northfleet.—The Empire Electric Power Co., Ltd., has given notice to the U.D.C. of its intention to apply for a prov. order to supply electricity in the area of Northfleet. The U.D.C. has appointed a committee to conduct negotiations with this and other bodies with regard to the supply of electricity to the town.

Northwich.—The U.D.C. has asked the local electric supply company for terms for adapting the existing street lamps for the electric light.

Pontypridd.—The U.D.C. has decided to erect its own electric generating station, instead of taking electrical energy in bulk from the South Wales Electrical Power Distribution Co.

Sunderland.—The T.C. has accepted tenders as follows:—The Electrical Power Storage Co., for a storage battery for the Whickham Street sub-station, and maintenance thereof for 10 years; and Messrs. Davidson & Co., for induced draught plant. An additional panel for the tramways switchboard at Dunning Street is to be obtained, at an estimated cost of £110

Provisional Orders.—Notices of application to the B. of T. for provisional orders have been lodged as follows:—Newquay and Marlow, by the Southern District Electricity Corporation. Bognor, by the Sir Hiram Maxim Electrical and Engineering Co., Ltd., the National Provincial Electricity Corporation, Ltd., and Messrs. Pressland & Fippard. Crediton, by Messrs. Christy Bros. and Middleton. Southwick, Skelton & Brotton, Barry, Whittington, and Brandon, by the Empire Electric Lighting Co. Brentwood, by the Sir Hiram Maxim Co. Ulverston, by the Electric Light and Power Co., Ltd. Ely, by the Sir Hiram Maxim Co., the Southern District Electricity Corporation, and the Empire Electric Lighting Co. Farnham, by the Sir Hiram Maxim Co. and the Inland Waterways, Ltd. Hanwell, by the Southall Electricity Supply Co. Rainham and Hollingbourne, by the Kent Electric Power Cos. Nailsworth, by the Gloucestershire Electric Power Co. Romford, by the Brentwood U.D.C. Dursley, by the Gloucestershire Electric Power Co. and the Western Electric Power Co. South Stoneham, by the Inland Waterways, Ltd. Dawley, Wellington and Paignton by companies.

Rotherham.—A loan of £13,390 has been applied for by the T.C. for E.L. purposes.

Scottish Central Electric Power Bill.—An amicable arrangement has been arrived at with the promoters of the above Bill, for the insertion of protective clauses in the interest of the various burghs. The company are held bound to take their water supply from the authorities in whose districts their generating stations are situated. A clause has also been inserted, whereby the company shall not enter the area of supply of the burghs of Stirling, Falkirk, Boness, and Alloa, and compete with them in the supply of energy, nor shall they be entitled to oppose any petition for the extension of the burgh boundaries by these burghs. In the event of the local authorities of Grangemouth, Alloa, Denny, Dunipace, and Kilsyth respectively becoming "authorised distributors" within the next three years, they shall be deemed to have been authorised distributors as at the commencement of the company's Act, and will, accordingly, have the same protective rights as other burghs which have an order.

Shepton Mallet.—The Western Electric Distribution Corporation and the Southern District Electricity Corporation have intimated to the U.D.C. their intention of applying to the B.O.T. for prov. orders to supply electricity in the district.

Sunbury.—The Twickenham and Teddington Electric Co. intends to apply for a prov. order for supplying electricity in the urban district of Sunbury.

Thornhill.—The U.D.C. has approved plans for the erection within the Council's area of an electric power generating station for the Yorkshire Electric Power Co. It is expected that work in connection with the construction of the buildings will be proceeded with as soon as the tenders are let.

Wolverhampton.—The town clerk has received a letter from the L.G.B. giving the Board's sanction to the Corporation borrowing £14,000 and £1,000 for electric lighting purposes. The Lighting Committee has issued the annual report and balance-sheet respecting the working of the electric light undertaking during the year. The Committee states that a gross profit was made of £11,698. out of which the following charges have to be met:—Interest, £3,659; sinking fund, £3,956; cost of change-over of system, £637; loss on sale of old engines, £966; leaving a net profit for the year of £2,480. The debt of £2,929 in respect of the engines is absolutely extinguished, and the cost of the change-over of the system of supply and the rewiring of consumers' premises has been £2,500, which has been paid out of the revenue. During the past year the output to private consumers for motive power has increased by 160 per cent. During the first four months of the financial year only a portion of the tramway routes was in operation, and the total output of electricity for tramway purposes has not been so large as was anticipated, but the additional day load has proved of considerable benefit to the undertaking.

ELECTRIC TRACTION NOTES.

Bath.—With regard to the failure of the Bath Electric Tramways Co. to comply with the Bath and District Light Railways Order, 1901, and the statements made by a deputation from the company thereon, the County Works Committee of the Surrey County Council has recommended (1) that the chairman of the County Council and of the County Works Committee be authorised at any time to direct proceedings to be taken against the company for contravening their provisional order, upon the report to them of the county surveyor, if it should appear desirable; (2) that the County Council consent to a proposal to alter the position of certain standards from the north to the south side of the Lower Bristol Road, subject to the approval of the county surveyor; (3) that the County Council decline to grant leave to the company to shorten the tramline on the Lower Bristol Road by about 150 yds., but that the company be allowed to construct a loop at the terminus, as shown on the plans, subject to the approval of the county surveyor.

Birmingham.—The Tramways Committee of the T.C. is at present negotiating with the neighbouring local authorities, and there is every indication that a working arrangement will be arrived at amicably between Birmingham and those localities which have not made arrangements with the B.E.T. Co. In the case of the latter there is every indication at present of perfect good feeling irrespective of the stiff fight before the House of Lords Committee recently. A conference was held this week with the authorities of King's Norton D C, and Handsworth D.C. Borrowing powers have now been obtained for £50,000 for tramway purposes, and £25,000 for a combined refuse destructor and electricity supply station. The length of tramline within the city to be purchased by the Corporation amounts to about 1½ miles. It was laid down in 1882, and came within the city at the extension of the municipal boundary in 1891. There may possibly be some disagreement, as the depôts are without the city boundary, and on this point the Corporation is determined not to deal. By the preamble of the Sutton Coldfield Bill being not proved so far as the tramways are concerned, the through route to Sutton Park, a favourite holiday resort of Birmingham, is indefinitely postponed.

Cardiff.—At a meeting of the Corporation Tramways Committee on Friday, it was reported that as a result of the first year's working of the tramways a net profit of £9,544 has been made.

Cheltenham.—Messrs. Dodd & Dodd, civil and consulting engineers, of Birmingham, have received instructions from the Cheltenham and District Light Railway Co. to prepare all necessary detail plans for deposit with the various local authorities to enable the Light Railway Co. to construct the authorised extensions to Charlton Kings and Leckhampton.

Dewsbury.—The B.E.T. Co.'s tramways in the Dewsbury district are rapidly approaching completion. The Batley lines are now being coupled to the Spen Valley main line, and the extension from the Dewsbury boundary through Ravensthorpe is about finished. It is hoped that the work will have so far advanced as to permit of the official inspection being made towards the end of the present month, so that the extension may be opened to the public from the beginning of August. It was a great disappointment to residents in Dewsbury, Soothill, Netter and Ossett when the Bill authorising the construction of a light railway from Dewsbury to Wakefield was thrown out. There is a strong feeling that tramways ought to be provided, and the Dewsbury and Ossett Corporations and the Soothill, Netter District Council are moving in the matter. A conference has been held at which it was agreed to recommend the three authorities to make a joint application to the Board of Trade for powers under the tramways to construct such a line.

Finchley.—In the matter of the dispute between the U.D.C. and the Middlesex C.C. as to the proposed light railways, the Board of Trade has determined that centre-pole construction must be adopted. The U.D.C., having received notice from the North Metropolitan Power Co. of intention to lay mains to supply electricity in bulk, and put down high-tension cables for the proposed light railways, has decided to object, and to inform the Middlesex C.C. that the U.D.C. is prepared to supply energy.

Irvine.—The T.C. has resolved to open negotiations with the County Council of Ayrshire and the Town Councils of the neighbouring burghs with a view to obtaining their opinions on the formation of a joint electric traction scheme for the district.

Italy.—Plans have been prepared for projected electric railways between Verona, Lagise and Riva di Trente, and between Peschiera and Lagise.

Leith.—Mr. James More, jun., has issued his report to the Corporation on the value of the present tramways and the cost of reconstructing for electric traction, with a view to the purchase of the undertaking by the Corporation from the Edinburgh Street Tramways Co. He values the present tramways at £78 513 Regarding the conversion of the present tramway lines to overhead electric traction, Mr. More thinks he is safe in assuming that every member of the Leith Corporation would be glad to see through communication between Edinburgh and Leith established. He considers several ways in which this can be done. The capital expenditure he estimates at £157,000, including:—Amount to cover purchase, £80,000; and cost of reconstructing the present lines and equipping them for overhead electric traction, £77,000.

Councillor McNab has proposed that the Town Clerk procure a return of the result of all Board of Trade valuations and arbitration cases during the last 10 years—the return to show the amount of total expenditure, the time in use, the depreciation, and the amount awarded, and the sum actually paid by the purchaser, and any other information calculated to assist the Council.

London.—SOUTHWARK.—Strong objection was taken at the B.C. meeting last week to the manner in which the electrification of the tramways was being carried on. Several members advocated that "lawlessness be met with lawlessness," that the ropes put up be cut, the trenches be filled in by the Borough Council's workmen, and that the material piled on the footways be carted away. Finally the following motion was carried: "That the L.C.C. be informed that this Council strongly object to the laying of the tramway ducts underneath the footways, and intend to appeal to the Board of Trade on the matter: also that all future disturbances of the roads in the district must be strictly carried out under Secs. 26 and 27 of the Tramways Act, 1870." These sections provide that only 100 yards of roadway be taken up at one time.

LAMBETH.—The B.C. is seeking to induce the L.C.C. to carry out the electrification of the Brixton cable tramway by working continuously night and day.

Melbourne Railways.—In the *Melbourne Age* for June 2nd we read that the Minister of Railways has obtained from Mr. J. D. Gillan, electrical inspector of the Public Works Department, a report dealing with the question of installing electric traction from Melbourne to Whittlesea *vid* Fitzroy. The scheme contemplates a continuous electric tramway between Whittlesea and a suitable terminus in the city. This Mr. Gillan considers to be practicable. The present permanent way to Whittlesea would be retained, but the scheme involves the construction of an electric tramway track from the city terminus to the south end of the Fitzroy railway branch Cockspur line *vid* Napier Street, and the copper bonding of the subsequent railway line, as well as the erection of trolley wire and feeder wires.

Mr. Gillan estimates the capital cost as follows:—

NORTHERN SECTION.—PRESTON TO WHITTLESEA, 17¼ MILES.

Water-power electrical generating station, transforming stations and plant, 300 H.P.	£11,800
Track, bonding, &c.	6,900
Trolley and feeder wires	31,000
Rolling stock	6,500
Total	£56,200

SOUTHERN SECTION.—MELBOURNE TO PRESTON, 8 MILES.

Steam-power electrical generating station, transforming stations and plant, 900 H.P.	£37,000
Track bonding, &c.	40,000
Trolley and feeder wires	16,000
Rolling stock	20,000
Total	£113,000
Grand total	£169,200

From this amount there would be a deduction of about £18,000 for the value of the railway locomotives and carriages at present in use, leaving a net amount of £151,000.

The annual cost of the scheme, including interest, depreciation, wages, water, stores, coal, &c., would be £47,900. The *Age* says:—"Mr. Gillan's report is interesting enough in its way, as showing the cost of electrically equipping a 25-mile section. But as a contribution to the question of converting suburban steam lines to electrical power it is worthless. An electric tramway from Melbourne to North Fitzroy would probably pay, but no one would ever dream of building an electric railway to Whittlesea, where the entire traffic could be accommodated in two carriages. The running of one steam train at present causes an absolute loss of £19,000 per annum to the department, and the idea of expending £56,000 more on the section from Preston to Whittlesea is sheer madness. The 1,200 H.P. to be provided would be expending its energy all day on nothing. The whole case for electric traction rests upon the possibility of running a constant service of cars, and thus keeping the power continually employed for the accommodation of a large traffic."

Middlesex.—The hearing of objections to the confirmation of the County of Middlesex Light Railways Order made by the Light Railway Commissioners took place on the 8th inst., at the Board of Trade, before Sir Herbert Jekyll, Assistant Secretary of the Railway Department. The Order authorised the construction of light railways in the parishes of Acton, Edgware, Edmonton, Enfield, Finchley, Friern Barnet, Hendon, Hornsey, Little Stanmore, Southgate, Tottenham, Wembley, Willesden, and Wood Green. The Order was passed subject to various alterations to be settled.

Southport.—Despite the resolution of the Electricity Committee not to supply current to the Southport Tramways Co. on Sundays, cars were run into Southport from Birkdale again on Sunday last. Current, it was understood, was procured by attaching "jumpers" to the connecting wires, as had been done the previous Sunday. Birkdale Urban District Council is inquiring into the matter, to ascertain whether the company are legally entitled to use current outside the township.

Sunderland.—At a meeting of the T.C. on the 8th inst., the Tramways Committee recommended that the minute of the Council ordering a double line to be laid down Lawrence Street be rescinded, and that a single line with turnouts be at once laid in such a manner as to allow a double line to be laid at any future time that is thought desirable. They also recommended that Messrs. Dick, Kerr & Co., Ltd., be engaged to carry out the permanent way and overhead equipment on terms to be approved by the Committee. The vice-chairman of the Committee (Mr. Bryers) in moving the adoption of the report that with a single line as was suggested, a 5 minutes' service could be had, and they thought that that would be sufficient at present; further it would mean a saving of £2,076. The present estimate for the line was £11,998. He also asked permission to withdraw a clause from the report recommending the adoption of the Thermit system of welding on the route. He stated that one of these welds recently made showed signs of giving way. The report was adopted.

For some time past the Electricity Committee of the T.C. has had under consideration an application from the Tramways Committee for a reduction in the price charged for electrical energy, which up to the present has been 2d. per unit. The matter was very deeply gone into with the result that the electrical engineer (Mr. J. F. C. Snell) drew up an exhaustive report on the matter in which he arrived at the conclusion that the tramways department were entitled to a reduction of ½d., which will make the price 1½d. per unit. That will make a difference to the tramways of £711 for the current year, and he states that he hopes to be able to advise a further reduction to 1¼d. from March 1st, 1904.

Walsall.—At the T.C. meeting on Monday a voluminous report was presented by the Tramways Committee. It was stated that the Board of Trade had consented to the re-laying of the existing tramway track in Lichfield Street and Lower Bridge Street, and the construction of the new loops on the Bridge, and a double line in Park Street, and had also approved of the proposed mode of construction.

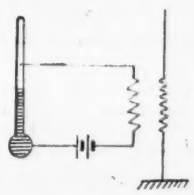
The action brought by the South Staffordshire Tramways Co. in relation to the sale of the tramways to the Corporation, which has been pending for nearly two years, has been abandoned by the company, who will have to pay the taxed costs of the Corporation in defending it, in accordance with the arrangement made with the lessee company. The Committee have been considering what arrangements it is necessary to make for efficiently managing the tramway undertaking by the Corporation as from January 1st next, and the town clerk has obtained from a number of Corporations owning and working their tramways on the overhead system information which has been of material assistance to the Committee. The total mileage to be worked by the Corporation is 12½ miles. The Committee recommend that the tramway manager receive a salary of £200 a year, rising to £250 by annual increases of £25. The Committee also recommend that the upkeep of the generating plant for tramway purposes, both at Wolverhampton Street and the transformer sub-stations, and the interest and instalment on the capital expenditure, estimated at £20,000, for providing the tramway electrical plant and sub-stations, and also any further expenditure for supplying current to the tramways, be charged to the Electric Lighting Committee, such Committee to undertake, at their own cost, the charge, control and up-keep of all such plant; that there be charged to the Tramways Committee the cost of the street equipment, namely:—Feeders and overhead wires; and that the expenditure be allocated accordingly. Respecting the price to be paid for current, it is estimated that about 500,000 car-miles will be run per annum, and that the annual consumption of current, based upon such mileage, will be about 500,000 units. The Committee recommend that the Electric Lighting Committee be asked to fix the minimum price of current for tramway purposes at not exceeding 2d. per unit, and informed that, if practicable, it is hoped they will be able to adopt a sliding scale of charges, so that as the consumption increases the price will be reduced. The report was adopted by the Council.

Wolverhampton.—Another lengthy discussion took place at the Town Council meeting on Monday respecting the tramways. It arose on the presentation of a balance-sheet showing the receipts and expenditure from the system during the past 12 months. Alderman Mander, the chairman of the Committee, claimed that there was a net profit of £4,130, and he predicted that, looking at what had been accomplished during the preceding year, there would be a profit on the subsequent year's working of not less than £12,000. Alderman Craddock, the deputy chairman of the Committee, was not, however, quite so sanguine as the chairman. He predicted that the profits next year would not be more than £10,000 or £11,000, even on the 11 miles of track.

On Tuesday a deputation of the Tramways Committee was to meet Mr. Wetmore, the representative of the Lorain Co., with the view of arranging terms to avoid arbitration. The members of the deputation, it may be added, are all sympathisers with the company, who, it is stated, stipulated that, before any conference was opened, the terms of the Corporation should be put in writing.

TELEGRAPH AND TELEPHONE NOTES.

Wireless Telegraphy as a Fire Alarm.—A novel application of wireless telegraphy has been devised by Mr. E. Guarini with a view to giving notice instantaneously and automatically to fire stations of any fire in the neighbourhood, and in a general manner to signal any excessive and dangerous rise of temperature in any buildings or enclosures provided with an automatic transmitter. The apparatus consists of a mercury thermometer, in the bulb and tube of which are introduced platinum contacts; the contact in the tube corresponding with the dangerous temperature. The contacts are in circuit with the usual wireless telegraphic instruments, with



the exception that the transmitter, which consists of a special toothed wheel, indicates automatically the street and the number of the building in danger. Under normal conditions the column of mercury does not reach the contact in the tube, and the circuit is open. If a dangerous rise in temperature occurs, the mercury rises in the tube, reaches the platinum contact, and the circuit is closed; the transmitter acts and signals the street and the number to the fire station, which is provided with a receiver. Thus the mercury acts as a key. Obviously, any number of mercury contacts may be used with a single transmitter, or any other form of temperature indicator could be employed.

Bournemouth Telephones. — The deputation which visited Portsmouth and Tunbridge Wells has reported on the municipal telephones there. They found that "there was no reason to anticipate that a municipal scheme would not be self-supporting" at Bournemouth.

Telegraph Rates to the Far East.—The Great Northern Telegraph Co., Ltd., on July 15th, introduced reduced rates for telegrams to China, Japan and the Philippines.

The Telegraph Wire Export Trade.—Only a relatively quiet trade prevailed last month as regards the export trade of this country in telegraph wire and apparatus connected therewith. The value of the shipments during June amounted to £76,721 as compared with £100,392 in May last and £46,866 in June, 1902. So far as the year has gone it has been, on the other hand, one of the most active on record, the shipments during the six months ending with June last having attained a value of £1,438,854, as contrasted with only £887,185 in the corresponding half of 1902.

Wireless Telegraphy. — The Prince and Princess of Wales are to visit Mr. Marconi's station at Poldhu on Saturday.

Telegraphic Interruptions and Repairs :—

Cables.	Interrupted.	Repaired.
Latakia-Cyprus	June 20, 1899 ..	..
Trinidad-Demerara No. 1	Aug. 27, 1901 ..	..
Dominica-Martinique	May 8, 1902 ..	..
St. Lucia-Martinique	May 8, 1902 ..	..
Guadeloupe-Martinique	May 9, 1902 ..	..
Martinique-Puerto Plata	July 10, 1902 ..	..
Cayenne-Pinheiro	Aug. 13, 1902 ..	..
St. Lucia-St. Vincent	Sept. 19, 1902 ..	..
Reissa-Issa	Oct. 22, 1902 ..	..
Reissa-Yemani	Oct. 22, 1902 ..	..
Paramaribo-Cayenne	Feb. 27, 1903 ..	..
New York-Haiti	April 13, 1903 ..	..
Siteebondo-Bandjermasin	July 6, 1903 ..	..
Landlines.		
U.S. of Colombia :—Landlines to Dagua ..	.. July 14, 1903 ..	..

CONTRACTS OPEN AND CLOSED.

OPEN.

Atherton. — July 28th. Electricity meters for the U.D.C. See "Official Notices" to-day.

Bath.—July 17th. Jet condensing plant, feed pump, pipe work, &c., for electricity supply extensions. See "Official Notices" July 3rd.

Bath.—July 27th. Main switchboard for the new generating station. See "Official Notices" to-day.

Birkenhead.—July 28th. One 350-KW. direct current steam dynamo for the Corporation. See "Official Notices" to-day.

Belgium.—Tenders are at present being invited by the Belgian State Railway Authorities at the Bourse, Brussels, for the establishment and equipment of a plant for electric lighting and power purposes at the railway workshops at Namur.

Blackburn.—July 27th. Main switchboard and accessories. See "Official Notices" July 10th.

Colne.—July 21st. Lancashire boiler, stoker, cable, condenser, &c. See "Official Notices" July 10th.

Guadeloupe.—August 29th. Tenders are being invited until August 29th next by the municipal authorities of Point à Pitre (Guadeloupe) for the concession for the public and private electric lighting of the town.

Hammersmith.—July 21st. Electric pumping plant for the Borough Council. See "Official Notices" July 10th.

Hungary.—August 31st. Tenders are being invited until August 31st next by the municipal authorities of Besztercsebanya (Neusohl) for the establishment in the town of a central electricity generating station of a capacity of 500 H.P.

Launceston (Tasmania). — September 28th. 500 or more electric meters. See "Official Notices" June 12th.

Leeds.—August 7th. Messrs. Graham, Morton & Co., Ltd., want tenders for the necessary electric cables, fittings, &c., for their new works. See "Official Notices" to-day.

London.—August 11th. Low tension feeder switchboards for the tramways sub-stations in Camberwell and New Cross. See "Official Notices" July 10th.

New South Wales. — September 12th. Tenders are being invited by the Railway Commissioners for New South Wales, for an additional generating set of 1,500 KW. for their tramway power station.

Pietermaritzburg.—July 29th. Six each single-deck bogie and double-deck single-truck cars for the Corporation. See "Official Notices" July 3rd.

Poplar.—July 22nd. Water softening plant for the workhouse. See "Official Notices" July 10th.

Portugal.—October 21st. Tenders are being invited until October 21st by the Portuguese Ministry of the Colonies in Lisbon for the concession for the electric lighting of the town of Macao in the Portuguese Colonies.

Preston.—July 22nd. Boiler house plant for tramways power station (economisers, feed heaters, and pumps). See "Official Notices" July 10th.

Rochdale. — July 28th. Copper rail bonds. See "Official Notices" to-day.

Sheffield.—July 21st. Electricity meters. See "Official Notices" July 10th.

Spain.—July 25th. Tenders are being invited by the Spanish Post and Telegraph Authorities for the supply of 4 tons of bronze wire 2 mm. diameter, and 8 tons of copper wire 3 mm. diameter. Tenders are to be sent to La Direccion General de Correos y Telegrafos Carretas, 10, Madrid, whence particulars may be obtained.

Spain.—Tenders are at present being invited by the municipal authorities of Dos Hermanos (province of Seville) for the concession for the public and private electric lighting of the town during a period of 21 years. Particulars may be obtained from, and tenders are to be sent to, El Secretario del Ayuntamiento de Dos Hermanos (Seville).

Stepney.—July 21st. Pipe work, water softening plant, and storage tanks, for the electricity works. See "Official Notices" June 26th.

Swindon.—July 23rd. Seven electric cars with trucks and motor equipments. See "Official Notices" July 10th.

Tiverton.—July 18th. Electric lighting installation for the borough. See "Official Notices" July 10th.

Wednesbury.—July 30th. The Corporation wants offers for free and hire purchase electric wiring and motors. See "Official Notices" to-day.

Weymouth and Melcombe Regis.—July 19th. Boilers, engines and dynamos, and various other plant for electric lighting. See "Official Notices" June 26th.

CLOSED.

Bolton.—The T.C. has accepted the tender of the B.T.H. Co. for the supply of a low-tension feeder switchboard.

Bradford.—The contract for the electric lighting installation at Horton Lane Chapel and Schools—the largest place of public worship in the city—has been secured by the Bradford Electrical Engineering Co.

Colchester.—On July 9th the T.C. accepted the tender of Messrs. J. G. White & Co. for the construction of the electric tramways as under :—Rails and fishplates, £7,049; points, crossings, junctions and fixings, £2,195; tie-bars, bolts and nuts, £350; bonds, £438; construction of permanent-way, £18,909; feeder cables, £2,096; poles, overhead equipment, and section boxes, £3,998. Messrs. White undertake to complete the works in three months, and agree to payment being deferred until the works have been completed and working for six months.

Coventry.—The Electric Light Committee of the Corporation has accepted the following tenders :—Aiton & Co., pipe work, £1,138; Green & Co., economiser, £286; Bennis & Co., coal conveying plant, £1,032; Danks & Co., flue doors and damper doors, £90.

Delagoa Bay.—Messrs. W. A. Baker, Ltd., of Newport, have secured the order for the supply of the constructional ironwork for the boiler house, engine room and car-shed for the new electric power station at Delagoa Bay, South Africa.

France.—The French Post and Telegraph Authorities in Paris have just given out the following contracts :—La Société Industrielle des Telephones, Paris, 10 kilometres of lead-covered gutta-percha insulated electric cables, 7 kilometres ditto, with 7 conductors, and 7 kilometres ditto, with 3 conductors; the India-Rubber and Gutta-Percha Co., of Persan-Beaumont, 10 kilometres ditto, with 7 conductors; Messrs. G. & H. B. de la Mathe, of St. Maurice, 30 kilometres of telephone cable (one conductor); Messrs. Geoffroy & Delore, of Clichy, 100 kilometres ditto, with two conductors, and M. Grammont, of Pont de Cheruy, 10 kilometres ditto, with 14 conductors.

Hammersmith.—The M.B.C. has placed an order with Messrs. Bruce Peebles & Co., for a special transformer at £243.

Houghton-le-Spring.—The tender of Messrs. Krauss and Co., Ltd., of Bristol, has been accepted for laying the permanent way of the electric tramways.

Islington.—The M.B.C. Lighting Committee has accepted the following tenders :—For supplying 159 induction motor meters, Electrical Co., Ltd., £559; for 36 induction motor meters, Brush Electrical Engineering Co., Ltd, £91 10s.

(*Continued on page* 105.)

THE NEW ELECTRICITY WORKS OF THE MANCHESTER CORPORATION.

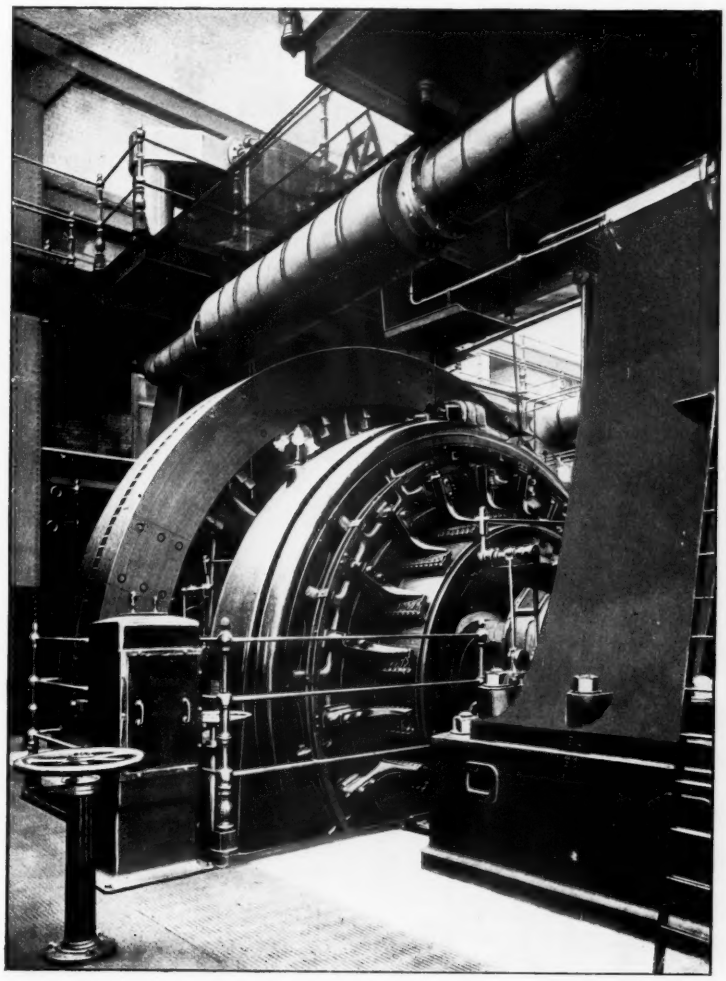
(*Concluded from page* 22.)

The generating station at Bloom Street is practically an extension of the original Dickinson Street station, from which it is separated only by an arm of a canal, crossed by a gangway; it was erected mainly for the purpose of supplying power to the tramways, and presents one of those rare instances in which a power station is designed and completely equipped from the very start, there being no possibility of extension on this site.

Owing to the shape of the site, the boiler house makes an angle with the engine room, leaving a triangular space between, as shown on the plan of the station given on p. 103. At one end of this space the chimney shaft is situated, with a 36 in. atmospheric exhaust pipe carried up one side of it.

The site is bounded on two sides by the canal, which lies along the whole length of the boiler house and one end of the engine room; the other two sides face Bloom Street and Winser Street.

The boiler house measures about 172 ft. × 36 ft., and contains on the ground floor 11 Babcock & Wilcox boilers, set in six batteries. Each boiler has a total heating surface of 5,140 sq. ft., and is composed of 18 sections of tubes, each section having 12 tubes in height, with an additional row of tubes constituting the firm's patent Scotch furnace or double combustion chamber, thus making the construction 13 tubes in height. The tubes are 4 in. in diameter, and 18 ft. long, and the sections are connected together by two steam and water drums, 48 in. in diameter and 23 ft. 7 in. long, connected at the rear end by a cross drum 20 in. diameter × 8 ft. 6 in. long. These boilers are capable of withstanding a working pressure of 160 lbs. per sq. in., and are fitted with B. & W. steam superheaters and chain-grate stokers. Each boiler is capable of evaporating 18,000 lbs. of water per hour, and the steam is normally superheated 100° F.



1,800-kw. Musgrave-Westinghouse Steam Dynamo.

Over the boilers are the economisers, of the Green type, there being 160 tubes in each of the 11 economisers; the scrapers are driven by Mather & Platt motors. Above the economisers are the feed-water tanks, and over all come the coal bunkers, which are capable of holding 800 tons of coal; this is brought to the works in wooden boxes, as is customary in Lancashire when the coal is water-borne by canal. A travelling crane, by Messrs. Stothert & Pitt, which runs along the top of the bunkers, lifts the boxes direct from the barges and tips the coal into the bunker where it is required.

The coal is fed to the boilers by gravity, the shoots being provided with measuring apparatus. The stokers are driven by Mather & Platt motors.

The feed-water arrangements are of an exceptional character, there being a separate equipment for each battery of two boilers; in fact, each pair of boilers, with two feed pumps and two economisers, forms an independent unit, and the connections are such that either pump can feed the boilers direct or through either economiser. The pumps were made by Messrs. G. & J. Weir, of Cathcart, and are installed in a basement beneath the stoking floor.

The ashes from the boilers are dropped into trucks and wheeled along a tunnel to barges on the canal. The chimney shaft is of brick, 223 ft. high and 12 ft. in diameter inside.

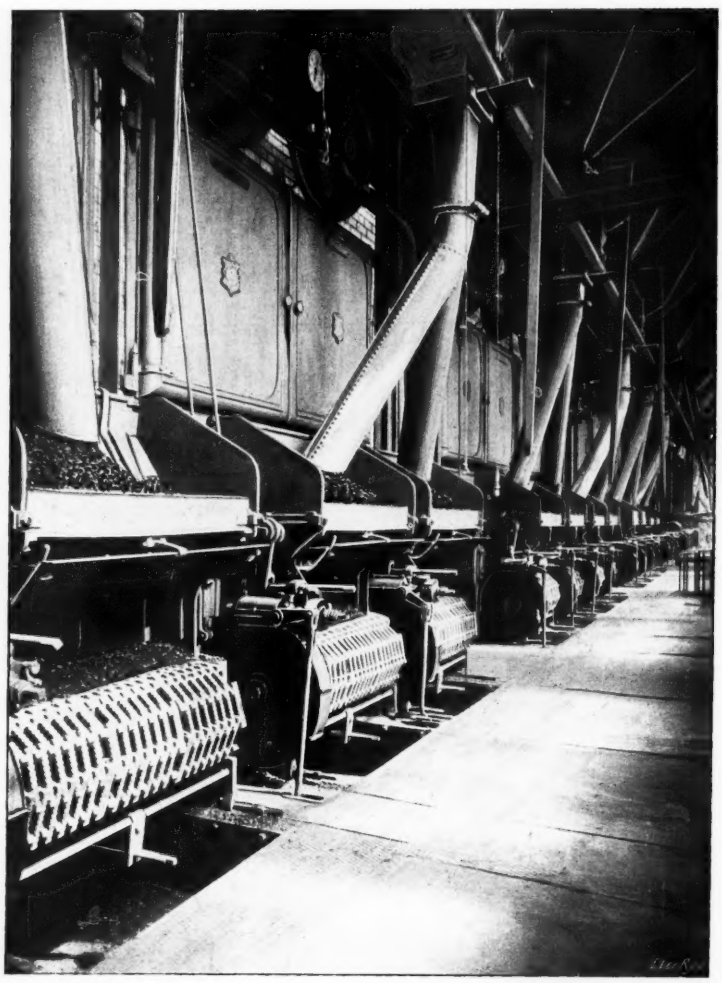
There are two main equalising steam pipes in the boiler house, each 14 in. in diameter, with a branch from each boiler to each pipe; each engine likewise has duplicate 13 in. steam pipes from these mains, as far as the main stop valve, with a separator on each pipe.

The engine room measures about 150 ft. by 44 ft., and is 36 ft. 6 in. high to the crane rails; the crane is electrically driven, with three motors and two speeds in lifting, and was supplied by Messrs. P. R. Jackson & Co. The room is admirably lighted from the saw-tooth roof with north light.

The generating plant consists of four Musgrave-Westinghouse steam dynamos, each giving normally 1,800

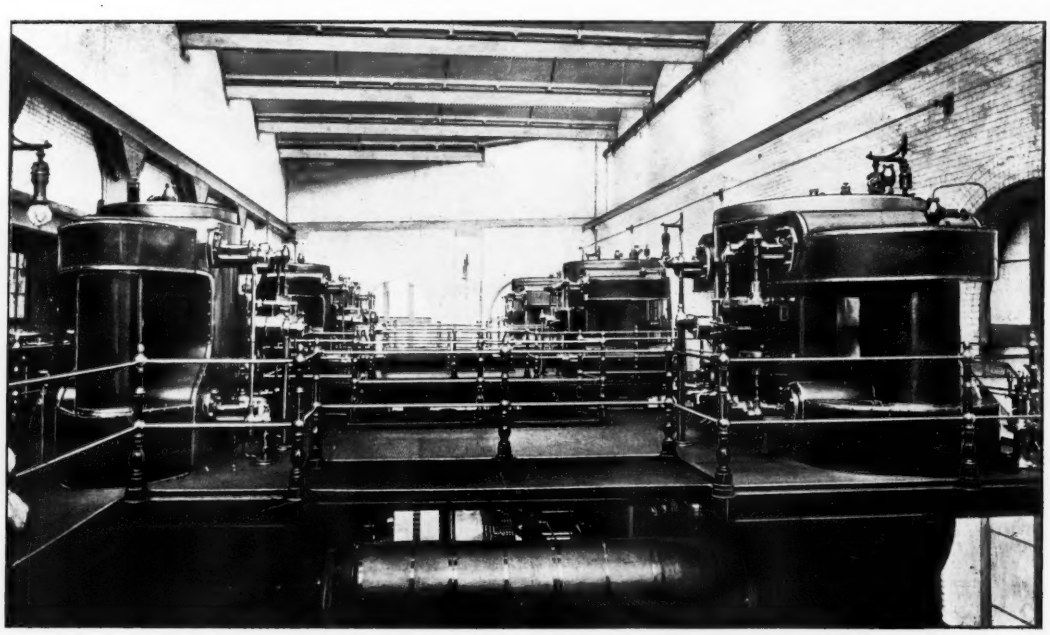
KW. at 75 r.p.m. The engines were made by Messrs. John Musgrave & Son, Ltd., of Bolton, and are of their vertical compound type, with the dynamos between the cranks. The cylinders are carried on very massive standards, rising from heavy cast-iron bedplates, and are fitted with Corliss trip valve gear, driven by separate eccentrics. Provision is made for controlling the valve gear of both cylinders by means of the governor, but it has been found preferable to use a fixed cut-off on the low pressure, and to govern the high-pressure cylinder only. An emergency governor is also provided. The gear is very quiet in action, and the engines themselves are practically noiseless, while the design is as usual admirable, not only in appearance, but also in working.

Each engine is provided with a fly-wheel weighing 125 tons, there being in all nearly 200 tons on the two main bearings. The fly-wheel is built up with 10 arms, and teeth are provided for the electric bar-



Babcock & Wilcox Boilers and Chain Grate Stokers.

The generators are of the Westinghouse Co.'s standard type. Each machine has a normal output of 1,800 KW., with a capacity for 25 per cent. overload continuously, or 50 per cent. for short periods. The overall dimensions of the frame are:—20 ft. 8 in. high, 5 ft. 3 in. wide, and 26 ft. long, while the commutator and armature diameters are 10 ft. and 12 ft. respectively. The armature is drum-wound, on a core built up on a heavy cast-iron spider, which is pressed on to the shaft and secured by shrinking rings before the fly-wheel hub is fitted in place. The commutator is constructed of 900 segments, insulated with mica, and fixed to the spider by clamping rings and bolts. The total weight of armature and commutator complete is nearly 38 tons. Carbon brushes are used, and each holder is bolted to a central ring, connected, through suitable gearing, to hand wheels at each end of the machine. The field frame contains 20 poles, of soft iron laminations cast into the

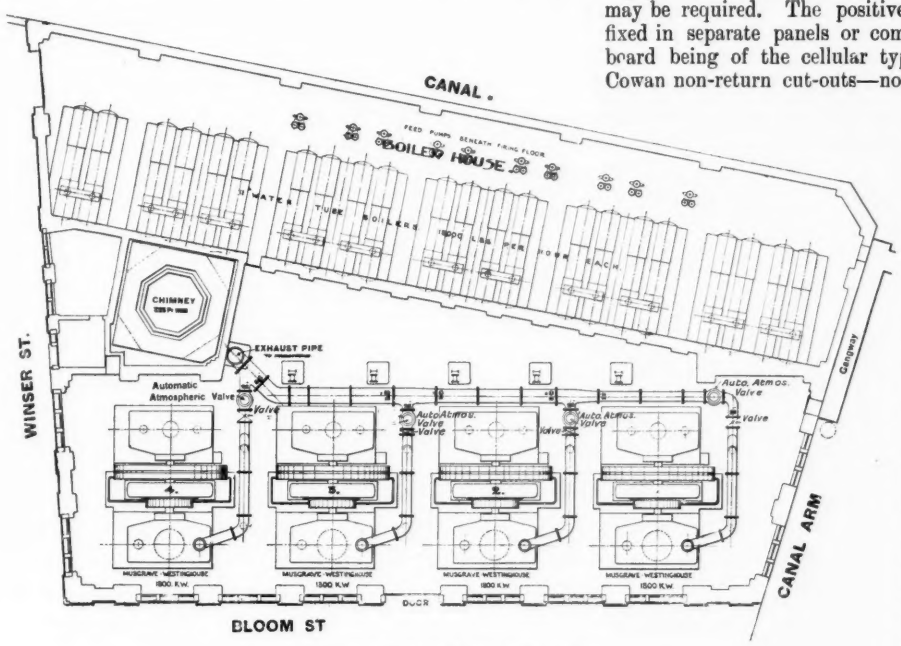


View of Upper Works of Musgrave 3,000-H.P. Engines.

ring gear in its outer periphery. The main shaft is 27 in. in diameter in the commutator end bearing, and 30 in. in diameter at the fly-wheel end.

yoke, which is split vertically to permit of examination of the armature at any time. The machines are designed for a speed of 75 revs. per min., and supply current either at 410—440

volts for lighting, or 500—550 volts for traction loads. For the former they are connected as shunt-wound generators, and for the latter as compound-wound, the change being effected by a switch pillar at the side of each machine, with interlocking gear to prevent the possibility of an error being made in changing over.



Plan of Bloom Street Station.

Each engine is provided with a separate surface condensing set, and the condenser is divided into two parts, with separate branches from the common exhaust pipe. The condensing plant is fixed in the basement between the foundations of the engines. Gwynne centrifugal pumps, driven by Westinghouse motors, supply the circulating water, which is obtained from the canal by means of four culverts, the hot water being similarly discharged at a point remote from the intake. The air-pumps are driven off the crossheads of the engines, there being two pumps to each set. The condensation water is run to waste, and the whole of the feed water is derived from the town mains; it would seem that there is room for improvement in this connection. The exhaust pipes are provided with automatic valves for exhaust to atmosphere in case of failure of the vacuum.

As will be seen from the plan, there is no space to spare in the station, which is completely filled. The triangular space between the engine room and boiler house has been roofed over and made use of as a switch-room.

The plant is used for both lighting and traction, working in conjunction with the Dickinson Street plant, and the bus-bars in the two stations are directly coupled together by stout cables, which are carried along a cable tunnel in the station, and are run in troughing, filled up solid with bitumen, over the gangway crossing the canal.

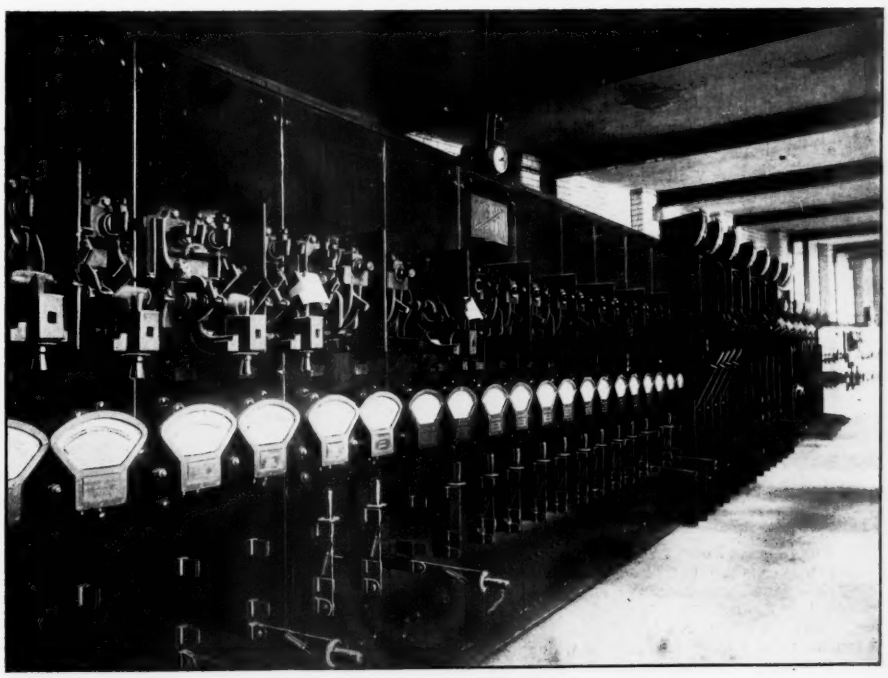
The generator panels are at the middle of the board, and are provided with throw-over switches, by means of which any generator can be used for either lighting or traction, as may be required. The positive and negative switches are fixed in separate panels or compartments, this part of the board being of the cellular type. Over the switches are Cowan non-return cut-outs—not maximum current circuit-breakers, which are only used on the traction feeders. At the top of the generator board are two lighting and two traction voltmeters, and an edgewise Evershed ammeter for each panel. Six generator panels are provided, four for the 1,800 KW. generators, and two for the two 750-KW. traction sets in the Dickinson Street station; the excitation of the latter is controlled from the switchboard in Bloom Street station.

Adjoining the generator panels is a paralleling panel for the connections with Dickinson Street, fitted with ammeters reading to 3,000 amperes, and main switches.

The traction feeders are 23 in number, each controlled by a main switch, Cowan circuit-breaker and ammeter. All the current to the tramways passes through the shunt of a recording ammeter, as the supply is charged for on the maximum demand system; separate watt-hour meters are also to be installed, to record the energy supplied for traction only.

The lighting feeder panels are six in number, on the right hand of the generator panels, and provide for 24 feeders, of which the positives are above and the negatives below, with edgewise ammeters at the top. The feeder cables are all coupled in pairs to single-switches.

Beyond the lighting board is a switchboard for controlling the station motors and lighting.



Ediswan Main Switchboard, Traction End.

The switchboard was constructed mainly by the Edison and Swan Electric Light Co., Ltd., with Eversheds instruments and Cowan automatic cut-outs, and British Thomson-Houston switches.

The station was originally designed by Mr. C. H. Wordingham, and the buildings were erected during his tenure of office; it was completed by Mr. G. F. Metzger.

Descriptions of the Dickinson Street stations have appeared in the Electrical Review from time to time, the latest being April, 1901; we do not therefore propose to deal with this beyond the reference which has already appeared in this article.

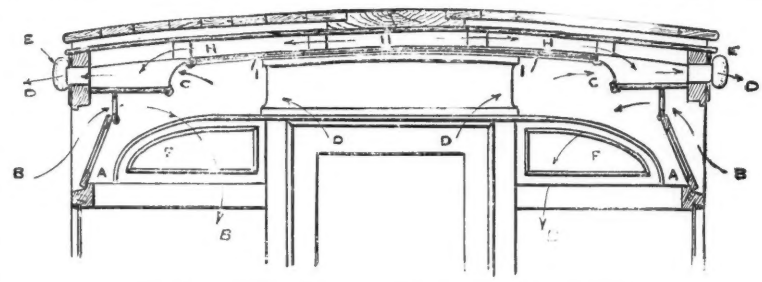


Diagram showing Improved Ventilating Arrangements.

Interior of Car.

In conclusion, we have pleasure in expressing our indebtedness to Mr. G. F. Metzger, city electrical engineer, for the facilities which he has kindly afforded us for the preparation of the article and obtaining photographs of the plant. Mr. S. L. Pearce, deputy electrical engineer, and Mr. McKenzie, resident engineer at Stuart Street, also afforded us valuable assistance, for which we return our best thanks.

IMPROVEMENTS IN CAR CONSTRUCTION.

Messrs. Dick, Kerr & Co., Ltd., have recently delivered to the Leicester Corporation a sample car built by the Electric Railway and Tramway Carriage Works, Ltd., Preston, Lancashire, which embodies some features that are new and important in tramcar construction. These features are principally an improved method of ventilation, and an improved design of interior finish, which taken together have produced a very satisfactory result.

The provision made for ventilation will be understood from the annexed diagram, which shows a cross-section of a top-seat tramcar roof constructed to provide for an inlet of fresh air and an outlet for the foul hot air that ascends to, and fills, the upper part of the car.

The inlet for fresh air is provided for through the usual line of hinged windows placed above the large fixed glass windows, which were first adopted by, and have since become an essential feature of, the Preston standard top-seat car. They are shown in the diagram at the points marked A, A, and the circulation of the air that takes place from the outside into the car is shown by the arrows marked B, B. With the use of these windows, experience has shown that the only thing wanting for thoroughly ventilating a tramcar is some provision for a further supply of fresh air from the outside into the car, and a means for the escape of the foul air, which cannot get out without interfering with the current of fresh air passing into the car through the hinged windows already referred to. This increased supply is provided for by a hinged sash on each side of the door at each end of the car, marked on the diagram F, F. These sashes can be opened in exactly the same way as the sashes A, A at the sides when additional fresh air is required. They are also provided with perforated louvre panels on the outside, and they admit of a large supply of fresh air passing inwards without interfering with the arrangement of coloured signal lenses, and without allowing the admission of water in wet weather.

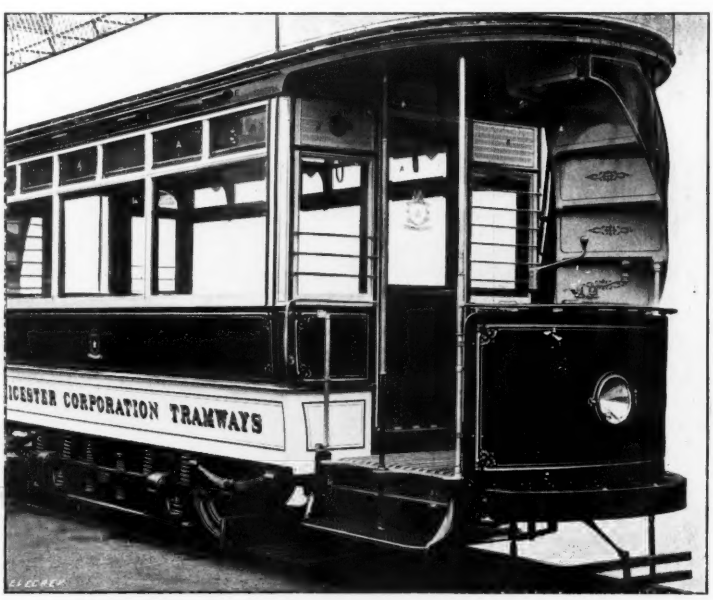
The outlet for the foul air has been provided for by a recess made in the roof of the car, marked C, C, which, as shown in the diagram, is just above the hinged windows above referred to. The circulation of the foul air through this recess to the outside is shown by the arrows marked D, D. On the outside of the car on each side and connecting with this recess are fixed ventilators, marked E, E, constructed in such a way that no air can pass into the car at these points, but the ventilators draw the hot air out when the car is running. It will be noted that this recess C, C connects not only direct with the interior of the car, but also with the roof space H, H between the millboard ceiling and the main deck, and that this space, which in ordinary tramcars is a dead air space, is thoroughly ventilated by this arrangement.

If required, a further outlet for the hot air in the top of the car may be provided for by perforating the millboard ceiling to connect with this space and, indirectly, with the ventilators on the outside of the car.

The foul air outlets cannot be closed, so that the interior of the car is constantly provided with a circulation of fresh air, without annoying draughts.

The application of this principle of ventilation to the car lends itself to very satisfactory treatment in the way of interior design and general finish, which adds very largely to its appearance.

The views given herewith show how the actual construction is carried out, the parts being lettered as in the diagram.



Exterior of Car.

No one who has travelled much in tramcars can be ignorant of the foul condition sometimes met with in their atmosphere, and every improvement in the ventilation, such as that here recorded, will be cordially welcomed by him.

CONTRACTS CLOSED.

(*Continued from page* 100.)

Gloucester.—The City Council on Wednesday accepted the following tenders:—

Section A.—Generating plant (79 tenders, ranging from £5,117 1s. to £3,282): the General Electric Co., (1900), Ltd., including English-made dynamos and Willans engine, £3,464 17s. 4d.

Section B.—Condensing plant and pipework (27 tenders, ranging from £1,206 to £835 10s.): Messrs. Summers & Scott, £890.

Section C.—Switchboard and instruments (27 tenders, ranging from £1,933 16s. 8d. to £1,136 8s. 5d.): Messrs. J. G. Statter and Co, £1,174 8s. 5d., subject to their satisfying the engineers on certain details of construction, &c.

Section D.—Battery of accumulators and reversible booster (31 tenders, ranging from £2,313 to £1,137 3s.): Messrs. Crompton and Co., Ltd., £1,551 11s.

At a meeting of the Tramways Committee held on July 3rd, Messrs. Dickinson & Hammond presented a report with analyses of the tenders received for the following sections, the Committee recommending that in each case the recommendation of the engineers should be accepted:—

Section E.—Rails and accessories (26 tenders, ranging from £15,398 to £13,132). Section F.—Construction of permanent way (23 tenders, giving schedules of prices which, according to quantities estimated by the city surveyor, would range from £15,511 to £29,828). The engineers reported that Mr. George Law's tenders were the lowest for Sections E and F combined, and that it would be an advantage for the same contractor for constructing the permanent way to be also responsible for supplying the material. The combined tenders of Mr. George Law, of Kidderminster, for Sections E and F, amounting together (approximately) to £47,655, were recommended subject to his agreeing to supply rails and other materials of British manufacture to be approved by the engineers.

Section G.—Cables, troughs and feeder pillars (23 tenders, ranging from £6,100 to £4,520): the British Electric Equipment Co. for Callender's lead-sheathed cables (the lowest), £4,520, subject to their giving the Corporation the option of having Callender's vulcanised bitumen-covered cables on the Corporation agreeing to pay the extra price charged for same by Callender's Cable and Construction Co., Ltd., the extra price being estimated at £584.

Section H.—Poles (26 tenders, ranging from £7,944 to £3,931): Messrs. J. G. White & Co., Ltd., £4,381 (the lowest complying with with the specification).

Section I.—Overhead line materials and rail bonds (22 tenders, ranging from £3,075 to £1,875 13s. 9d.) Section J.—Erection of poles and overhead equipment (18 tenders, ranging from £8,345 17s. to £876 11s.): the British Electric Equipment Co. for sections I and J, amounting together to £2,857 9s. 10d. (the lowest tender for the two sections).

Section K.—Car bodies and trucks (32 tenders, ranging from £7,680 to £5,112 18s.): the Brush Electrical Engineering Co, Ltd. (the lowest complying with the specification), £5,417.

Section L.—Electrical equipment of cars (24 tenders, ranging from £4,929 15s. 6d. to £3,689): Messrs. Dick, Kerr & Co., Ltd. (the lowest), £3,689.

Manchester.—The Corporation has again accepted the tender of Messrs. Rowland Carr & Co. for the supply of box-compound for 12 months' requirements of the electrical department.

Leigh.—The Tramways and Electricity Committee has let the following contracts:—Babcock & Wilcox, Ltd., water-tube boiler; Isaac Storey & Sons, Ltd, condenser, oil separator and feed pump; Klein Engineering Co., Ltd., cooling tower; Chamberlain and Hookham, Ltd, electricity meters.

Littleborough.—The U.D.C. has accepted the tender of the Rochdale Electric Co., Ltd., for the complete electrical equipment of its new supply station, together with the wiring of the Carnegie Library, municipal offices, new Board Schools, &c., to the specification of Mr. W. C. C. Hawtayne.

Llandilo.—The U.D.C. has placed the order for engine, generator, boiler and switchboard with Messrs. Bertram Thomas, Manchester. The generator and switchboard are both to be of this firm's own manufacture. This is the first extension to the station. The whole of the original plant and cables were also supplied and erected by the same firm.

London.—The L.C.C. has placed its contract for British-made high and low-voltage lamps with Mackey's Electric Lamp Co., Ltd.

Maidenhead.—The T.C. has accepted the following tenders:—Extension of steam, exhaust, feed and other pipes, feed pump, &c, Messrs. Aiton & Co., £490; extensions to switchboard connections of new dynamo, Messrs. Johnson & Phillips, £236; water tower, Klein Engineering Co., £240; circulation pump, Messrs. J. H. Carruthers & Co., £140.

West Ham.—The Corporation has accepted the tender of the Harris Patent Feed Water Filter, Ltd., for a feed water purifying plant at £1,100. Messrs. Macartney, McElroy & Co., Ltd., have been asked to proceed with the overhead equipment of the Barking Road tramways, as an extra order under their contract and at the schedule rates therein.

ADDENDUM TO ELECTRICITY WORKS LISTS.

SHEFFIELD.—Add one generating set; total capacity of plant, 5,125 KW. Max. load, 2,797 KW. Total capital exp., £619,855. Pr. ltg., 212,722 8-C.P.; lamps added, 46,965. Motors 209, of 1,104 H.P. Ltg., 4d.; power, 2d. to 1d. Units sold, 2,919,722; price obtd., 3·56d.; works costs, ·98d.: total costs, 1·28d.

THE MUNICIPAL ELECTRICAL ASSOCIATION.

THE eighth annual convention was opened on Wednesday at Sunderland. Notwithstanding very adverse weather, the assembly was a large one. The members were welcomed by the Mayor, who referred to the importance of municipal electrical undertakings, and to their dependence upon the members of the Association. He commented upon the rapid strides made in electrical work, and the great importance of choosing the latest type of machinery. Sunderland had invested half a million sterling in its undertaking. The President, Mr. J. F. C. Snell, thanked the Mayor for his remarks, and then delivered his presidential address, a lengthy abstract of which appears on other pages of this issue. Alderman Norman, of Cheltenham, moved a vote of thanks to Mr. Snell, and in doing so, expressed his appreciation of the services rendered by municipal engineers as a whole, and hoped that the Association would give evidence before the Royal Commission on Municipal Trading in support of the President's contention. Bailie Maclay, of Glasgow, seconded, and bore testimony to Mr. Snell's abilities. He trusted that much valuable information would be disseminated, as it was a case in which it was equally blessed to give and to receive. The Mayor and the President briefly returned thanks.

Subsequently Mr. Alderman Smith, of Barrow, read his paper on "Statistics of Electrical Supply," and a lively discussion ensued, the remarks being mainly devoted to the controversy of Company *v.* Corporation. On behalf of the companies, Messrs. Madgen and Vesey-Brown and Major-Gen. Webber took a leading part, somewhat upsetting the equanimity of the meeting, so that it needed all the efforts of the civic representatives of Glasgow, Bolton, York and Doncaster to soothe ruffled feelings.

Unfortunately, as a result of this debate, Mr. Chamen's paper on "The Possibilities of future Economies in Electrical Illumination" had to be taken as read, through lack of time. A few brief remarks, however, were made in respect to it, Dr. J. W. Swan taking part.

The company subsequently took luncheon at the Town Hall, at the invitation of the Corporation, municipalists and anti-municipalists sitting down together, lion and lamb-like.

The usual loyal and local toasts were given with full musical honours.

Before proceeding to visit the electrical works, as arranged in the programme, the party was victimised by the inevitable camera fiend.

NOTES.

A Trafford Park Fatality.—One day last week a workman named Clague, at the Westinghouse Works in Trafford Park, received a fatal shock. A 50-ton crane in the steel foundry had not been working satisfactorily, and men employed upon it had complained of receiving slight shocks. Clague, along with another man, went upon the crane, which is 70 ft. from the ground, to do some work. He entered the switch cage to turn on the lights, and had no sooner done so than he received a shock, which proved instantly fatal.

South African Notes. — Our Johannesburg correspondent writes:—

Bulawayo.—Mr. Laughton, the town engineer, has been appointed electrical inspector, in addition to his ordinary duties.

Natal Parliament.—A Select Committee has been appointed to inquire into the Sydenham Electric Tramways Bill. The Durban County Tramway Bill has passed the second reading. It has been suggested in Parliament that direct telephonic communication be established between Durban and Johannesburg.

Lourenço Marques.—Mr. A. E. Saunders, the superintendent of the South African Telegraph Co. at Lourenço Marques, has just left for England on a 12 months' furlough, his place being taken, *pro tem.*, by Mr. J. R. Smith, late superintendent of the Mauritius station of the Eastern Telegraph Co.

Port Elizabeth.—The Town Council is considering an offer from the South African Lighting Association to light the street lamps at a rate of 9s. 6d. per lamp per month.

An electrical installation was recently completed by Messrs. Johnson & Fletcher, at the Globe and Phœnix Mine at Bulawayo. A 175-H.P. Belliss engine, running at 400 r.p.m., drives by belt a three-phase alternator for 550-volts pressure. A blue Vermont marble switchboard is provided, with four panels. Three three-phase motors have been put in, the largest for driving the workshops being 40 B.H.P. A 20-H.P. motor drives a triplex vertical pump. To reduce the working expenses of the cyanide plant, a 15-H.P. motor has been erected to work a haulage system which will carry the tailings from the leaching vats to the tailings dump.

The John Fritz Medal.—Mr. C. W. Hunt, of New York, the secretary of the John Fritz Medal Fund Corporation, has placed before us a pamphlet relating to the John Fritz medal, in which the rules of the award and the conditions under which it is made are fully set out. The medal is to be awarded by the Corporation "to that person who shall be selected as being entitled thereto for the most notable scientific or industrial achievement." The board consists of four members of each of the American Civil, Mining, Mechanical and Electrical Engineers' Institutes. Mr. Hunt's address is 220, West Fifty-seventh Street, New York.

Junior Institution of Engineers.—At a recent meeting of this Institution a lecture on "High Frequency Electric Discharges" was given by Mr. R. P. Howgrave Graham, A.I.E.E. The lecturer first explained the principles of "self-induction" and "capacity," and the conditions necessary for their combination to produce oscillatory discharges of exceedingly high frequency. The range of frequency of electric oscillations up to 30,000 millions per second was briefly sketched, and some attention was given to practical details. The enormous effects of self-induction were demonstrated by various striking experiments. An account, illustrated by lantern slides, was then given of the work of Nikola Tesla and others, after which several beautiful experiments with a large Tesla coil were shown, including direct and brush discharges at very high voltages. Amongst other examples, the very high voltage current, after passing along a single transmission wire of No. 40 Eureka, flowed through the primary of a small coreless transformer and into an insulated metal plate, there being no return wire. The secondary, with only five turns, lit a 25-volt lamp. Eventually the transmission wire was cut and the power for a smaller lamp was transmitted by electrostatic induction between two plates more than 1 ft. apart. A vote of thanks was accorded the lecturer, special reference being made to the highly successful series of brilliant experiments with which the lecture was illustrated.

Electricity in Mines.—At Cardiff, on Friday, the 10th inst., the South Wales and Monmouthshire Institute of Engineers discussed at great length a paper on electricity as "The Motive Power of the Future," submitted by Mr. Horace D. B. How, A.M.I.E.E. Mr. How attributed the prejudice against the application of electricity in mines to ignorance, and its baseless forebodings and apprehensions. Let colliery managers say what they wanted and then electrical engineers would do what was wanted. He had no hesitation in offering to put down armoured cable, polyphase machinery, and switch gear, to do any duty that might be required in the most fiery mine in South Wales, and to work the plant and stay down for six months to look after it. He had already pointed out, in some gatherings, that there was no desire on the part of electrical engineers (as some mining engineers seemed to think) to ram electricity down their throats; but let them look round and see where electricity could profitably be used, and having decided that, put it in regardless of cost. If, by spending £10,000, they could effect a saving of £5,000 a year, the advantage of the first cost was obvious. Mr. How received hearty thanks for his paper. Principal Griffiths, D.Sc., also, during the initial discussion, impressed upon the Institute the fact that if the idea became fixed in their minds that electricity could not be safely used underground, they at once handicapped investigation. Mr. W. Scott, A.M.I.E.E., also submitted a paper on "Electric Motive Power in Mines and Collieries."

Obituary.—We learn with regret of the death of Mr. Killingworth Richard Hedges, which occurred on July 10th, at Montagu Square, London. Mr. Hedges was perhaps better known among electrical engineers in the earlier years of the industry, when his attention was engaged with central electric station questions. In more recent years he had devoted himself very zealously to the subject of lightning and the protection of buildings therefrom. He had acted in an advisory capacity in connection with the protection of St. Paul's Cathedral and numerous important public buildings, both in this and foreign countries, and latterly rendered great service in connection with the Lightning Research Committee, whose work has frequently been referred to in our columns. The funeral took place at Sunbury-on-Thames on Tuesday.

Appointments Vacant.—An improver (£52) is wanted for Tonbridge; engineer-in-charge (£104) for Bermondsey; assistant superintendent in the Indian Government Telegraph Department, at Rs. 4,200 per year; chief clerk for the Mansfield electricity department; switchboard and sub-station attendants for the Manx Electric Railway Co.; chief assistant electrical engineer at Hoylake (£125). See "Official Notices" to-day.

Compounded Asynchronous Machinery.—With reference to Mr. G. Hooghwinkel's article, which commences on p. 122 of this issue, we perhaps should mention that this contribution would have appeared much earlier but for the pressure upon our space. It has been in our hands for some weeks.

Personal.—Mr. Llewelyn B. Atkinson, A.M.I.C.E., has recently joined the board of Messrs. W. T. Glover & Co., Ltd. His lengthy experience with all classes of mining work will be especially valuable, now that this branch of engineering is coming under the influence of electricity.

Mr. Frank Broadbent, M.I.E.E., consulting engineer, has changed his offices from 5, Bond Court, Walbrook, E.C., to 4, Queen Street Place, E.C.

Electrical Engineer's Libel Action.—Mr. Justice Lawrance, sitting with a special jury in the King's Bench Division on Wednesday, heard an action by Mr. S. P. W. Sellon, civil engineer, 36, Victoria Street, against the *Daily News* for damages for alleged libel contained in an article published in November last. The defendants denied the libel, and pleaded justification. Mr. C. F. Gill, K.C., and Mr. C. W. Mathews appeared for the plaintiff, and Mr. Rufus Isaacs, K.C., and Mr. Hugh Fraser for the defendants

Mr. Gill said the plaintiff had attained considerable eminence in his profession, and had been appointed by Mr. Bryce, when President of the Board of Trade, to the Commission which inquired into the question of light railways, the outcome of which was the Light Railways Act. He was also consulted by a large number of Corporations and private clients, and was retained by the British Electric Traction Co. at a salary of £1,500 a year. The *Daily News* last autumn had published a series of articles on "Municipal Socialism," and the one of which the plaintiff complained was a strong attack on the British Electric Traction Co. It mentioned plaintiff by name, connecting him with Jabez Spencer Balfour and Henry Granville Wright, and the tone of the article reflected discreditably on him, and imputed professional misconduct. Plaintiff complained to the editor of the *Daily News*, who said he would correct any inaccuracy that could be pointed out, but apart from that there was nothing which he could apologise for or withdraw.

The plaintiff gave evidence, and said the Electric Traction Corporation, which was the predecessor of the British Electric Traction Co., was quite a different undertaking from that with which Jabez Balfour and Henry G. Wright had been associated. He complained that the article did not make this clear, and that it suggested that after assisting in getting the Light Railways Act passed, he proceeded to reap the benefit of it.

Cross-examined, Witness said he did not complain of the facts set forth in the article, but only of the comment. The British Electric Traction Co. sometimes came into conflict with local authorities in connection with tramway undertakings, but he had never acted as consulting engineer to both. It was contrary to his agreement.

The jury returned a verdict for the plaintiff with one farthing damages.

The Atkinson-Schattner M.D. Indicator.—This indicator has been approved by the Board of Trade.

The Hotwell as Oil Extractor.—Water carries oil into the boilers simply because sufficient time has not been allowed for the oil molecules to separate out of the water by gravity. This is due to the small difference of gravity between oil and water, and to the viscosity of the water which will not give way to the push of the oil particles caused by the difference. A paper recently presented to the American Society of Mechanical Engineers by A. H. Eldridge, describes a hotwell in which, by means of vertical baffle walls of simple form, all oil is claimed to be kept out of the boilers. It is an easy matter to build tanks with vertical baffle plates to compel underflow of the water from condensers. These will effect good separation; but a separator of water placed in the course of the exhaust pipe seems to remove most of the oil with the water and should prove beneficial in keeping the condenser tubes free from oil likewise. So, also, centrifugal effects may be brought to bear on emulsified oil, and the gravitation effect increased in the ratio $w-w : w^2-w^2$ where w and w are the respective specific gravities of the water and of the oil to be separated.

The Navy Boilers.—It appears as though an attempt were on foot to revive the Belleville boiler, the *Europa*, having been retubed, and the *Spartiate* have come home from the East, and much fuss is being made of their performance. One of them, the *Europa*, has averaged 10·75 knots, the other 13 knots. Now these ships are supposed to run at 20 knots, or even more. The resistance of a ship and the power required vary as the cube of the speed. Thus $20^3 = 8{,}000$ and $13^3 = 2{,}197$, so that the faster ship only came home at about one-fourth its power. It has all along been recognised that the Belleville or any other boiler would be right for easy steaming. There is an enormous latitude for easy work when a ship

runs at quarter power. She can work half her boilers at half power, and go on to the other half when the slightest trouble occurs, but it is a poor ground on which to base a panegyric upon the Belleville boiler.

Liquid Fuel for Power Purposes.—Continuing his articles in the *Engineering Magazine*, Mr. A. L. Nelliston points out the importance of considering the liquid fuel problem from a conservative standpoint owing to the limited amount so far available, the total output of the United States in one year (1901) being under 70 million barrels, or sufficient only to develop 3 million H.P.-days of 10 hours, a mere fraction of the world's total power, quite apart from the use of the greater part of American oils for lighting and lubricating purposes. In certain areas the use of oil fuel does pay, and the radius of its commercial use extends obviously to such a point that the advantage is swamped by the less price of coal. Oil is an economy in various directions. It diminishes labour in stoking, ash removal, cleaning, stand-by losses and interest on surplus plant owing to the greater facility it affords for sudden spurts of energy. Clearly, then, every case must be considered by itself before accurate conclusions can be drawn. There is in addition the æsthetic advantage of cleanliness. As regards smoke, however, oil has the advantage only because it is really worse than coal; so much worse as to have compelled the use of appliances and methods and principles which would make coal fires also smokeless. Coal is so much less smoky than oil that it is allowed to be burned on incorrect principles; oil compels attention and gets it. The author shows by simple calculations the maximum efficiency to be hoped for from oil fuel. The efficiency of oil can be greater than coal, probably because it is cleaner and free from dust and combustion temperatures are higher, being less diluted with cold air in excess, so that the maximum efficiency of oil may be secured at a higher rate of steam production than the point of maximum efficiency of coal, in one case reaching as high as 78·5 per cent. when the evaporation rate was 3·74 lbs. per sq. ft. of heating surface, as compared with a maximum for coal of 71·4 per cent., and 2·22 lbs. evaporation, a gain of 7·1 per cent. in efficiency, and 68 per cent. in capacity. Additional savings due to oil arise from the constantly closed furnaces, but this advantage appertains also to the mechanical stoking of coal. About 2½d. per ton in favour of coal is, however, allowed to provide for repairs to brickwork, owing to the expansion stresses due to higher temperatures. It appears to be in the brickwork, and not in the boilers, that oil becomes more costly in repairs. It appears likely that if oil becomes more plentiful and in greater demand, it will urge forward the production of such new refractory materials as siloxicon, which are the product of the electric furnace at high temperatures, and therefore suitable materials for high temperature furnace work.

THE CENTRAL STATION ENGINEER.

Mr. R. A. Chattock, electrical engineer to the Corporation of Bradford, has been recommended by the Electricity Committee for appointment as chief electrical engineer to the Corporation of Birmingham at £1,000 per annum, in place of Mr. J. C. Vaudrey, who is retiring. There were 79 applicants, and the short leet consisted of Mr. McCowen, Belfast; Mr. Thursfield, Chester; Mr. Chattock, Bradford; Mr. Giles, Blackburn. Mr. Chattock is 38 years of age, and a native of Solihull, Birmingham. He was educated at University College, London, served his apprenticeship at Blackwall Ironworks, and has had experience with the Metropolitan Electric Supply Co., Ltd., also as Chief to the St. John's Vestry, Hampstead, and at Bankside before going to Bradford, where he has been three years.

Mr. W. T. Wardale, assistant engineer at Peterborough, has been appointed shift engineer at the Sheffield Corporation Tramway Power Station.

Mr. J. E. Doidge, late chief assistant at Malta Electricity Works, has been appointed assistant to the Municipal Council at Shanghai, at a salary of 175 taels per month.

Mr. Yapp, assistant engineer at the Sutton Electric Lighting Works, has left Sutton to take up the post of chief engineer at the Sheerness Electricity Works.

Mr. H. L. Percy, of the Wimbledon Council's Electricity Department has been appointed assistant engineer at Chesterfield.

On Saturday, 11th inst., the employés of the Wimbledon Urban District Council, Electricity Department, held their annual outing, a most enjoyable day being spent at Portsmouth. Various objects of interest, both in and out of the town were visited in turn, chief among which were the dockyard, and the home fleet lying off the town. Dinner was served at the Esplanade Hotel, Southsea, when the usual complimentary toasts were exchanged. Owing to the unavoidable absence of the chief engineer, Mr. Treacher presided, and was ably supported by the mains engineer, Mr. Nott, and Mr. Percy, senior engineer, who, as mentioned above, is leaving to take up the post of chief assistant engineer at Chesterfield. The weather was perfect and the day was a great success.

The West Ham Lighting Committee has decided in favour of the electrical engineer being authorised to purchase a motor-car for £300 for the use of himself and his staff.

The first annual outing of the employés of the Stamford and Grantham Electric Lighting Co. took place to Yarmouth on 9th inst. The party numbered 42. Dinner was served at the Savoy Restaurant.

■ Mr. C. F. W. Dudding, who is leaving the Hastings Electricity Works to take up a position as chief electrical engineer in South Africa, was on 4th inst. presented with a centre-second chronograph stop watch, by the staff and workmen. Councillor Bones, chairman of the Electric Light Committee, made the presentation. One interesting remark was made by Mr. Dunning in acknowledging the presentation. We quote it as affording an instance of the peripatetic way of the central station man. He said he was the oldest servant in the offices, having seen all of the others leave. Although he had only been at Hastings for three years many changes had taken place.

The staff and employés of the Paisley Electricity Department recently went for their annual outing to Millport. After boating, obstacle and wheelbarrow races, dinner was served at the Cumbrae Hotel. Bailie Fisher presided, with Mr. Parkinson, the electrical engineer, as croupier. A drive round the big Cumbrae was followed by further sports and tea. A tea service was presented to Mr. Barbour for the work done by him in connection with the trip. The presentation was made by Mr. R. Wilson on behalf of the wiring contractors. We understand that Bailie Fisher and Mr. Parkinson bore part of the expenses of the outing.

NEW COMPANIES REGISTERED.

Havana Electricity Co., Ltd. (77,897).—This company was registered on June 30th, with a capital of £300,000 in £10 shares, to adopt an agreement with Senor Don Tiburcio Castaneda and La Compania de Electricidad de Cuba, to construct, equip, develop, and control railways, tramways, electric light, telephone, and telegraph works and other public or private works and conveniences in Cuba and elsewhere, to acquire and turn to account any contracts, decrees, and concessions, to acquire and hold all or any part of the shares and bonds of La Compania de Electricidad de Cuba (incorporated under the laws of Cuba, and having for its objects, *inter alia*, the construction of works, &c., under a concession for the establishment in Havana of plant for supplying electric power and motive force), to acquire shares and obligations of any other company, and to carry on the business of suppliers of electric light, heat and power, constructors of cables, wires, lines, accumulators, lamps, and the like, generators and distributors of electricity, electricians, mechanical engineers, financiers, &c. The first subscribers (each with one share) are:—E. G. Farish, 57½, Old Broad Street, E.C., solicitor; W. H. Fay, 21, Seymour Place, Fulham Road, S.W., clerk; E. Jackson, 25, Mimosa Street, Fulham, S.W., clerk; F. C. Booker, 47, Princess Road, Kilburn, N.W., book-keeper; J. C. Fay, 31, Kilmaine Road, Fulham, S.W., clerk; J. F. Cooke, 140, Ardgowan Road, Catford, S.E., clerk; W. H. Barry, 115, Warren Road, Leyton, book-keeper; and J. Cowdry, 158, Praed Street, W., clerk. Minimum cash subscription seven shares. The first directors are E. G. Farish, W. H. Fay, E. Jackson, F. C. Booker, J. C. Fay, J. F. Cooke, W. H. Barry, and J. Cowdry; qualification, £200; remuneration, £1,000 per annum, divisible. Registered office, 4, Coleman Street, E.C.

Portpatrick Electric Supply Co., Ltd. (5,386).—This company was registered in Edinburgh on June 25th, with a capital of £2,000 in £1 shares, to carry on the business of suppliers of electricity in all its branches. The first subscribers (each with one share, except Lieut. Boyle, whose holding is not stated) are:—C. L. Orr Ewing, Dunskey, Portpatrick, Wigtown, M.P.; Mrs. Orr Ewing, Dunskey, Portpatrick, Wigtown; James Boyle, 2nd. Lieut. Royal Scots Fusiliers; J. Kennedy Hunter, 51, Sandgate, Ayr, architect; G. Smith, Dunskey, Portpatrick, Wigtownshire, factor; J. P. Harris, Dunskey, Portpatrick, Wigtownshire, clerk of works; J. Gordon, 12, Cathedral Street, Glasgow, electrical engineer; and J. J. Coats, 198, W. George Street, Glasgow, writer. C. L. Orr is the first director. Registered office, Dunskey Estates office, Portpatrick.

Hyde Electrical Manufacturing Co., Ltd. (77,929).—This company was registered on July 4th, with a capital of £5,000 in £1 shares, to acquire the business of electrical and mechanical engineers carried on at Hyde, Ches., as the "Pollard Electrical Engineering Co., Ltd.," and to carry on the business of electrical engineers, electricians, suppliers of electric light, heat, and power, owners of telephone and telegraph systems, manufacturers of cables, wires, lamps, accumulators, and electrical accessories, &c. The first subscribers (each with one share) are:—E. Bunting, Werneth View, Gee Cross, Hyde, cycle maker; J. H. Hinder, Glebe House, Moorside, Denton, electrical engineer; J. Oldham, Ash Mount, Gee Cross, Hyde, cork manufacturer; C. H. Broyden, The Firs, Chapel Street, Hyde, auctioneer and valuer; J. Hindle, Irwell Vale House, Edenfield, near Manchester, cashier; Mrs. A. Chadwick, Birchfield, Gee Cross, Hyde; and Mrs. M. Bunting, Werneth View, Gee Cross, Hyde. No initial public issue. Registered without articles of association. Registered office, Mary Street, Hyde.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Ackroyd & Best, Ltd., Lamp Manufacturers, Morley (54,600).—Issue on June 11th of £2,750 debentures, part of a series created December 8th, 1902, to secure £10,000, charged on the company's undertaking and property, present and future, including uncalled capital. Trustees under deed of May 14th, 1903: C. T. Naylor, Hazeldene, Hayward's Heath, and J. P. Humble, Threelands, Birkenshaw. Previously issued of same series: £5,250.

Buenos Ayres Electric Tramways (1901), Ltd. (71,206).—A trust deed dated June 8th, 1903, to secure £185,000 debenture stock (the company having power to issue not more than £15,000 further stock ranking *pari passu* with this issue) has been registered. Property charged: Concessions or rights for construction of electric tramways in Buenos Ayres, about 64,000 sq. ft. freehold land, the benefit of clause 10 of an agreement with the South American Syndicate, Ltd., as to guaranteeing interest on stock, and the company's undertaking and property, present and future, including uncalled capital. Trustees: W. Greenwell, 2, Finch Lane, E.C., F. C. Traiks, 145, Leadenhall Street, E.C., and T. T. White, Bank Chambers, 2, Cockspur Street, W.

W. H. Allen, Son & Co., Ltd., Mechanical and Electrical Engineers, Bedford (66,440).—Issue on June 19th of £24,100 second debentures, part of a series created June 15th, 1903, to secure £40,000. Property charged (subject to £40,000 first mortgage debentures), the company's undertaking and all present property (except uncalled capital), including freehold hereditaments at Bedford; leasehold premises, part of 66, South John Street, Liverpool; and two rooms at 27, Old Queen Street, Westminster. Trustees: Law Guarantee and Trust Society, Ltd., 49, Chancery Lane, W.C. No previous issue of same series.

Guildford Electricity Supply Co., Ltd. (36,725).—Issue on June 23rd of £300 debentures, part of series created November 19th, 1900, to secure £15,000, charged on the company's undertaking and property, present and future, including uncalled capital. No trustees. Previously issued of same series, £13,800.

Eastern Telegraph Co., Ltd. (6,338).—Issue on June 17th of £10,000 debenture stock, ranking *pari passu* with previous issue, amounting in the aggregate to £1,829,120. Property charged: The company's undertaking and revenue. Holder: F. R. de Levanté, 141, Hill Street, Peckham, S.E. No trustees.

Frinton-on-Sea and District Electric Light and Power Co., Ltd. (70,689).—Issue on May 29th of £500 debentures, part of a series created May 7th, 1903, to secure £3,000, charged on the company's undertaking and property, present and future, including uncalled capital. Holders: W. Webster and Miss A. A. Mackay, 50, Lee Park, Blackheath, S.E. No trustees. No previous issue of same series.

Central Electric Supply Co., Ltd. (53,080).—An acknowledgment of indebtedness under seal, dated June 10th, 1903, creating £50,000 further debenture stock (making with debenture stock already created £300,000, and being supplemental to a trust deed dated July 2nd, 1901, securing £250,000) and an instrument of charge of even date under the Land Transfer Acts, 1875 to 1897, securing £55,000 with respect to the issue of the said stock, have been registered. Property charged: land comprised in charge dated March 4th, 1902; trustees, the Hon. A. Lyttleton, K.C., 3, Paper Buildings, Temple, and W. H. Fisher, M.P., 18, Buckingham Palace Gardens, S.W.

Royce, Ltd., Electrical Engineers, Hulme (63,871).—Issue on June 9th of £700 debentures, part of series created March 27th, 1903, to secure £25,000, charged on the company's undertaking and property, present and future, excluding uncalled capital. Trustees: Law Guarantee & Trust Society, Ltd., 49, Chancery-Lane, W.C.; previously issued of same series, £11,400.

Grant's Drill and Trolley Co., Ltd. (71,933).—A debenture dated May 27th, 1903, securing £500, charged on the company's undertaking and property, present and future, including uncalled capital (subject to prior charges for £1,000 and £500 respectively), has been registered. Holders: The Corlett Electrical Engineering Co., Ltd.

Codd Arc Lamp Co., Ltd. (77,217).—£800 first mortgage debentures created and dated May 25th, 1903, charged on the company's undertaking and property, present and future, including uncalled capital, have been registered. No trustees.

Electric Danite Syndicate, Ltd. (76,275).—Issue on June 9th of a debenture for £100, part of a series created February 6th, 1903, to secure £1,000, charged on all the company's present and future capital, stock, and property. Holder, R. Diespecker. No trustees. Previously issued of same series, £700.

British Electric Car Co., Ltd. (66,840).—Trust deed, dated June 17th, 1903, to secure £50,000 debenture stock has been registered. Property charged: Specifically on freehold land, premises, and hereditaments in Stretford, Lancs., and (as a floating security) on the company's undertaking and property, present and future, including uncalled capital. Trustees: W. S. Laycock, Sheffield, and W. M. Murphy, Suffolk House, Laurence Pountney Lane, E.C.

Satisfaction in full of a charge dated March 15th, 1902, securing £25,000.

Newcastle-upon-Tyne Electric Supply Co., Ltd. (27,937).—Issue on May 28th of £66,200 debentures, part of a series created October 3rd, 1901, to secure £250,000. Property charged: The company's undertaking and property, present and future, including uncalled capital. No trustees. Previously issued of same series: £153,400.

ELECTRICITY SUPPLY ACCOUNTS.

Swansea Corporation Electrical Department.

The second year's figures of the Swansea Electrical Department give good promise of a progressive and prosperous future for that undertaking. With an increased output of 80 per cent. and an improved load factor, the working expenses have dropped by practically ¼d. per unit, and the gross profit amounts to more than double that of the previous year. In the working expenses, the most appreciable reductions are found in rent, rates and taxes, and management and general expenses, the total costs being now 1·48d. per unit.

During the year the capacity of the generating plant has been increased from 525 kw. to 1,725 kw., and judging from the present maximum load, this should meet the demands of the next year or two. Of the total of 578,182 units sold, 424,752 were for private lighting, 90,240 for public lighting, and 63,190 for power purposes. The prices charged are:—Lighting, 6d. and 2d. per unit (maximum demand); power, 2d. and 1½d. per unit (maximum demand); and public arc lamps, £25 per annum each. Mr. C. A. L. Prusmann is the borough electrical engineer.

General Statement.

For year ending March 31st—		1902.	1903.	Inc.
Total capital expended		£60,231	£89,596	£29,365
Number of units sold		319,215	578,182	258,967
Equivalent number of 8-c.p. lamps		23,166	42,112	18,946
Load factor		8·61	12·06	3·45
Maximum load in kilowatts		423	547	124
Revenue Account. Gross revenue		£4,571	£8,300	£3,729
" expenditure		£2,308	£3,722	£1,414
" profit		£2,263	£4,578	£2,315
Average price obtained per unit		3·44d.	3·42d.	—·02d.

Revenue Statement.

	1902. Gross.	1902. Per unit.	1903. Gross.	1903. Per unit.	Inc.
By sale of energy	£4,571	3·44d.	£8,249	3·42d.	—·02d.
Meter rentals, &c.	—	—	51	·02d.	+·02d.
Gross revenue	£4,571	3·44d.	£8,300	3·44d.	·00d.

Working Expenses.

	1902. Gross.	1902. Per unit.	1903. Gross.	1903. Per unit.	Inc.
Coal	£697	·52d.	£1,224	·50d.	—·02d.
Water, oil, waste and engine room stores	136	·10d.	231	·09d.	—·01d
Wages on generation	481	·36d.	865	·35d.	—·01d.
Wages on materials on repairs and maintenance of buildings, plant, instruments, tools, accumulators, mains, meters, switches, fuses, &c.	18	·01d.	126	·05d.	·04d.
Wages and materials on public lamps	41	·03d.	225	·09d.	·06d.
Works and distribution costs	£1,373	1·02d.	£2,672	1·08d.	·06d.
Rent, rates and taxes	307	·23d.	333	·13d.	·10d.
Management expenses, salaries engineer's department, clerical staff, stationery, printing, law charges, insurance and general establishment charges	628	·47d.	655	·27d.	—·20d.
Total works costs	£2,308	1·72d.	£3,650	1·48d.	—·24d

Profit Statement.

	1902.	1903.
Interest on loans	£2,612	*£2,768
Sinking fund	—	—
Balance carried forward	—349	1,810
Gross profit	£2,263	£4,578

* Includes deficiency, 1902.

Financially the department ends the year with a balance o £1,810 to the good, after paying interest on loans and deficiency o 1902. It has, however, provided nothing in the way of sinking fund or depreciation.

Colchester Municipal Electric Supply.

We give, herewith, the returns of the Colchester Electrical Department for the year ended March 31st, 1903.

During the year a considerable increase in business has occurred, and the class of business, as indicated by the increased load factor, is on the upward grade. The revenue shows a decreased average price per unit of ·5d., but this is, in a great measure, neutralised by decreased works costs, averaging ·38d. per unit, and Mr. Sellar is to be congratulated on having succeeded in bringing the latter to such a reasonable figure as 2·80d. per unit, in the face of the necessarily heavy fuel charges, and the comparatively small possibilities of his area in the way of a day load.

The prices charged are, for private lighting, 7d. and 4d. per unit on the maximum demand system, and for power, 4d. to 2¾d., with discounts in both cases.

General Statement.

For year ending March 31st—		1902.	1903.	Inc.
Total capital expended		£34,130	£41,549	£7,419
Number of units sold		180,166	265,310	65,144
Equivalent number of 8-c.p. lamps		15,704	21,965	6,261
Load factor		8·56	10 69	2·13
Maximum load in kw.		239	283	44
Revenue Account. Gross revenue		£4,316	£5,600	£1,504
Gross expenditure		£2,386	£3,094	£707
Gross profit		£1,930	£2,506	£576
Average price per unit sold		5·20d.	5·02d.	—·18d.

Revenue Statement.

	1902. Gross.	1902. Per unit.	1903. Gross.	1903. Per unit.	Inc.
By sale of energy	£3,904	5·20d.	£5,565	5·02d.	—·18d.
Meter rents, &c.	412	·55d.	255	·23d.	—·32d.
Gross revenue	£4,316	5·75d.	£5,820	5·25d.	—·50d.

Cost of Production.

	1902. Gross.	1902. Per unit.	1903. Gross.	1903. Per unit.	Inc.
Coal, &c.	£973	1·29d.	£1,230	1·11d.	—·18d.
Oil, waste, water and engine-room stores	206	·27d.	190	·17d.	—·10d.
Wages incurred in generation and distribution	317	·43d.	504	·45d.	·02d.
Repairs and maintenance of buildings, machinery, distributing plant, &c.	191	·25d.	358	·33d.	·08d.
Works and distribution costs	£1,686	2·24d.	£2,282	2·06d.	—·18d.
Rent, rates and taxes	78	·11d.	85	·09d.	—·02d.
Management expenses, salaries engineer, clerical staff, general establishment charges, printing, stationery, law and insurance	622	·83d.	726	·65d.	—·18d.
Total works costs	£2,386	3·18d.	£3,094	2·80d.	—·38d.

Profit Statement.

	1902.	1903.
Interest on loans	£749	£1,133
Sinking fund	707	1,016
Surplus for the year	474	357
Gross profit	£1,930	£2,506

CITY NOTES.

Electrical Power Storage Co.

The fourteenth ordinary general meeting of the shareholders of this company was held on Thursday last week at Winchester House, Old Broad Street, Mr. J. Irving Courtenay presiding.

The Chairman, in proposing the adoption of the report, said he thought the shareholders might be congratulated upon the position of the company, and it afforded the directors the utmost satisfaction to feel that they were justified by the steady improvement in the company's business in recommending an increase of 1 per cent. in the dividend, which would make it 6 per cent, while continuing the cautious policy of again transferring £5,000 to the reserve and £1,000 to the contingent fund. The trading for the year ended May 31st, had resulted in a profit of £11,129 3s. 1d., or with £854 14s. 9d. brought forward £11,983 17s. 10d. After dealing with the sum as proposed in the report they would carry forward £594 4s. 3d. The reserve would then stand at £20,000, and the contingent fund at £6,000, thus materially strengthening the company's financial position. Besides increasing the reserves they had thoroughly maintained buildings, plant, tools, &c., at a cost of £2,256 11s. 6d., and had written off £1,245 18s. 2d. for depreciation, both out of revenue. The depreciation account was somewhat heavier than last year, due to the additions they had made at their Millwall works, which were leasehold property. Their output for last year had exceeded that of any previous year, and in addition to their usual business in smaller batteries for lighting and traction purposes, they had completed, during the past year, more than 20 large installations in connection with lighting and power stations in various parts of the kingdom. Those included Barnsley, Bury, Birkenhead (two batteries), Brighton, Broughton Ferry, Cleckheaton, Dublin, Falkirk, Garston, Gateacre, Hornsey, Jarrow, Midland Railway, Nottingham, Newcastle, Newport, Norwich, Underground Electric Railways of London, Walsall, Aldershot Camp, Whitehaven and Yarmouth, and they had in course of erection or on their books at the beginning of the year orders for 13 similar installations. He was glad to say that in every department the works were fully employed. It spoke strongly for the excellence of the company's manufactures to be able to say, as they could say, that when once they had secured a customer, in the large majority of cases he came back again and again, and that was especially a striking feature in their central station work. The new Carzonode plate had created considerable interest and had achieved most satisfactory results wherever it had been used. They had had a very large sale for batteries for propelling electric carriages, and in that connection they had been steadily continuing experiments with the company's own vehicles, and collecting a mass of valuable statistics. He thought they could safely say that the Electric Power Storage experience in that direction was second to that of no other company in this country or elsewhere. Competition had been quite as severe as in previous years, and they had also had an American invasion, as the latest storage battery company on the other side of the water had acquired the control of one of the competing company's in this country. They were quite alive to the possibilities of further competition that might ensue, but he could assure them that Mr. Butler and their staff were well prepared to meet it should it become necessary. He took that opportunity of saying in regard to the sensational statements that appeared from time to time in some of the newspapers with regard to Mr. Edison's battery, that there was no fresh fact connected with it which would tend to modify the opinion they formed when the battery was first brought out, and that the opinion in America was similar to that held by them—that the battery was no nearer to being a commercial battery than it was three years ago. The shareholders would gather from what he had said that they had full confidence in the stability and prospects of the company.

Mr. F. Green seconded the motion, and the report was adopted.

United River Plate Telephone Co.

The seventeenth ordinary general meeting of the shareholders of this company was held on 2nd inst. at Winchester House, Old Broad Street, Mr. J. Irving Courtenay, the chairman, presiding.

In proposing the adoption of the report, the Chairman called attention to the fact that it dealt with a period for the most part anterior to the great improvement resulting from the bountiful harvest with which the River Plate had been favoured, the full benefit of which had not yet been felt. Nevertheless, the company had progressed throughout, and the increased prosperity of Argentina must undoubtedly still further improve the prospects of the company. Unusual expenditure for maintenance and renewals was occasioned in the early part of the year by the removal of the chief central exchange from the location it had occupied for more than 20 years in Calle San Martin to their building in the Avenida de Mayo, and, during the latter months, by storms of extraordinary severity in the province of Buenos Aires, which seriously damaged some of their most important lines in many directions. Their underground plant, established and being extended in Buenos Aires and commenced elsewhere, would remedy to a considerable extent the risks from these severe storms, but their pole lines must always be subject to possible injury from that source. Before passing to the accounts, he might say that, although the reports for a number of years past had been of a satisfactory nature, the position of the company to-day was better and stronger than ever. They covered now, to a great extent, the city and province of Buenos Aires, the richest and most populous district in South America, and they also occupied the two most populous cities in Argentina outside that district—Rosario and Cordoba. They had extensive underground plants in operation and in progress in Buenos Aires and in Cordoba, and they intended to put down similar plants in other important localities. They were thus strongly located in the leading centres of the Republic, and they might with confidence look forward to a reliable future for the business and to its increasing importance. In preparation for that, they were acquiring new central office properties, increasing their underground plant, placing metallic circuits, strengthening and improving their pole lines, and making betterments generally in the many directions demanded by future as well as by present requirements. In reviewing the balance-sheet, taking the credit side first, they would note the increase of capital outlay, £80,219, which included the considerable extensions from Buenos Aires and elsewhere, and those of the underground plant, the work in Cordoba and the acquisition of the Provincial Telephone Co. That expenditure brought in during the year over 1,000 new subscribers, and its chief value was yet to appear. Real estate, which consisted of their central office properties, had increased £3,400, and stock of materials £3,800. Securities, £104,189, had decreased by £16,300. He might mention that those, excepting an amount in Argentine local investments, which cost something less than £600, were quoted on the Stock Exchange, and represented a market value of, say, £2,000 above their cost price. Bills receivable stood at £9,500 less than last year, and cash at bank, &c., £25,500 less. All of those differences were covered by the capital expenditure and outlays. Turning to the debtor side of the balance-sheet, they would note that neither the share issues nor the debenture stock had been increased, the large capital outlay for the year having been made out of cash reserves. The item of sundry creditors was increased by £10,400, through a larger amount of stores, mainly for their underground work, for which the accounts were not payable until after March 31st. The reserve fund, which stood at £75,000, was being increased this year to £95,000. Taking the profit and loss account, it would be seen that their receipts in the River Plate, £124,400, were £9,600, and that the charges to maintenance, &c., were £8,000, more than last year. In the appropriation of profit, the figures naturally differed from those of a year ago, the writing off and the extra amount paid as interim dividend alone accounting for more than the difference in the balance brought down. They again, for the fourth year, paid a 7 per cent. dividend, placed £20,000 to reserve, and carried forward £3,713.

Mr. Frank W. Jones seconded the motion, and the report was adopted.

Electric and General Investment Co., Ltd.

Mr. Geo. Herring presided at the meeting held at Winchester House on July 8th. In proposing the adoption of the report, he said that the gross profit for the year had amounted to £19,424. That was a falling-off from last year, but he had always told them that they must not expect each year to produce the same results; the profits must vary more or less with the public condition of the business, by which he meant that if it was a good year to promote companies and to float them, then it was a good year for them. Last year, as they would all know, had not been a good one in that respect, and, therefore, the gross profits were so much less. The report stated that after meeting all charges and interim dividends there remained a balance of £8,996, and the directors proposed to take £1,003 from the contingency fund to make that amount up to £10,000. Last year they put £10,470 to the contingency fund, and he told them at the time that there was nothing behind the accounts, and that they were not keeping back anything. He now told them that, in the opinion of the directors, it was only a fair and proper thing to take that £1,000 from the contingency fund in order to make the dividend 35 per cent. In addition to that dividend on the ordinary shares, the trustees for the reserve fund proposed to distribute the sum of 6d. per share. Within a small fraction that 6d. a share represented all the profits that had been derived from the securities invested; and the same remark applied to the founders' share reserve fund. They had not sold any of the securities from either of those funds during the year. Turning to the balance-sheet, the capital was unaltered. The amount standing as provision for contingencies, £36,764, would be lessened by £1,003 if the report was adopted. The loan account stood at £309,211, which might appear somewhat heavy, but they had more than sufficient securities to cover that amount without reckoning their investments. Sundry creditors figured in the balance-sheet for £49,000, but that was a mere question of how they stood in the books on May 31st. He looked over the books the previous day and found, roughly speaking, that about four-fifths of that sum had since been paid. On the other side there was the item of investments at cost—£299,758. They were not quite so good as they were a year ago, but because he told them last year that they were not quite up to the price put upon them, he did not wish the shareholders to run away with the idea that there had been any serious loss on them. As a matter of fact, there had only been a very slight loss indeed. Shareholders must not forget that a company like that must be speculative as far as the dividends were concerned. When they got dividends of 35 per cent., 45 per cent., and on one occasion 55 per cent., they must naturally understand that they might vary, and because the directors had had to take this £1,000 from the contingency fund this year, he did not wish shareholders to think there was anything wrong with the company.

Mr. J. B. Braithwaite, jun., in seconding the motion, said he thought the best evidence of the stability and soundness of the company was the fact that, even after taking away that £1,000, the

contingency fund still stood at about one and a third times the amount of the paid-up ordinary share capital.

The report was adopted.

British Electric Traction Co., Ltd.

THE seventh ordinary general meeting of this company was held on Wednesday of last week at Hamilton House, Victoria Embankment, E.C., Sir Charles Rivers Wilson in the chair.

In moving the adoption of the report, the CHAIRMAN said he was glad to be able again to congratulate the shareholders on the continued progress of the company's business. Dealing with its financial side, he said that the gross profits had increased from £203,269 to £238,961. They had, however, to pay interest on a much larger capital than last year, so that although the profits were somewhere about £35,000 larger, they were not able to recommend the payment of the same rate of dividend on the ordinary shares as last year without reducing the amount to be carried forward. It was proposed that the dividend for the half-year should be at the rate of 10 per cent., which would make the dividend for the whole year 8 per cent. That would enable them to carry forward £24,912 as against £27,438, the amount carried forward during the preceding year. They had had to pay £139,925 for debenture interest and preference dividends, as against £88,854 during the year ended March, 1902. The prior charges, therefore, absorbed all but £4,000 of the increased profits. The reduction of the dividend by 1 per cent. was due mainly to a larger amount of new capital having been expended during the year, which, during the period covered by the accounts, had not become productive of profit, but which, nevertheless, had to rank for interest or dividend. There was another, but a minor reason. They had experienced very unfavourable weather for tramway traffic. The reduced dividend did not imply that the business was becoming less profitable. As a matter of fact, in all essential matters, the business showed a decided improvement. They had carried 170,000,000 passengers during the year as against 97,000,000 in the previous year. The receipts from the traffic amounted to £922,000 as compared with £563,000. The company had also 288 miles of line in use as compared with 228. Dealing with the profits which came from the various associated companies, the chairman said that those profits showed a steady increase. The proportion of profits received in the form of "dividends, interest, fees and commission," had increased, as follows:—For the 14 months ended December, 1897, it amounted to £3,000, for 1898 it was £18,000, for the 15 months ended March, 1900, £62,000; for 1901, £72,000; for 1902, £156,000; and for the past year, £264,000. This sum of £264,000 was received partly in the form of dividends on shares, interest on debentures and interest of loans, partly from engineering experts and Parliamentary fees, and partly from directors' fees paid by the associated companies. Other fees and commission amounted to £79,000. With regard to the experts, the British Electric Traction Co. retained the services of a number of engineering and electrical experts, and it was a saving to the associated companies to be able to have their advice when needed. The gross profit was made up as follows:—Dividends and interest, £138,000; engineering and Parliamentary fees, £30,000; directors' and managers' fees, £16,200; pupils, transfer and guarantee fees, £1,300; other fees, £79,000; profit on the working of lines, sales of investments, &c., £29,000; and profits on sale of undertakings, of Parliamentary powers, underwriting profits, £11,600; or a total of £305,100. From that sum they had to deduct £66,170, the expenses and losses directly chargeable, so that the figures remained £238,961. They had also to charge against the year's profits the expenditure on contracts and undertakings they had not proceeded with. The amount was £12,490. Returning to the effect of the weather on the traffic receipts, the chairman said he would take the figures during the Whitsun week in each year. If Whitsun week, 1901, were represented by 100, then the traffic receipts for the same week in 1902 would be represented by 77½, and the receipts during the same week of this year by 105. Taking the whole matter into consideration, there was no cause for surprise or disappointment at the slight reduction of dividends; on the contrary, it was a matter for congratulation that they could pay so high a dividend as 8 per cent. With regard to the expenditure of new capital, that money was not received until July, and yet it had been made to rank for full dividend from the day it was received. The shareholders were, therefore, receiving out of the year's profits interest at 8 per cent. on £200,000, which at present did not contribute anything like that amount. The company had issued over 23,000 ordinary shares to the shareholders of the Brush Electric Co., and 8,853 ordinary shares had also been issued to the shareholders of the Electrical Power Distribution Co. All of those shares ranked for a full year's dividend. During the year they had issued £212,912 of the debenture stock, and the whole amount had been placed on advantageous terms without having recourse to a public issue. The total received on all issues amounted to £1,007,280. Dealing with the proposal to issue second debenture stock, he said that it was necessary that they should raise a larger proportion of their capital at a lower rate of interest than was payable on the share capital. It had been suggested, therefore, that the directors should be empowered to borrow up to an amount equal to the share capital; that would enable them to issue second mortgage debenture stock. The issue of second debenture stock would not in any way affect the rights of the first debenture stockholders. It would, on the contrary, materially improve their security, by reason of the additional capital which would rank after them, and the ordinary shareholders would be benefitted, as it would decrease the average cost of the capital. The directors had not come to any decision as to how much should be issued, or when and they had not decided the rate of interest or the price of issue. He then dealt with the company's investments, and said that they showed a considerable increase. In Consols, and in the debentures and shares of associated companies, the amount invested stood at £3,569,658 as against £2,332,932, the amount in the preceding year. They had added to their holding in Consols. It was desirable that the reserve fund should be real, and £200,000 of it had been invested in Consols, the rest being employed in the business. It was no doubt a fact that some of the investments were worth more than the figure at which they stood in the books, but, on the other hand, were were some which at present would not realise par, and one or two might leave a loss. He did not think, however, that it would be wise to deal with the investments in any other way. It was a matter of impossibility to make an annual valuation of them. Dealing with certain statements which had lately appeared in the Birmingham papers, he said that there had been a series of remarkable mis statements in regard to the company's methods. For many years the company had worked steadily to consolidate the tramway system in the Black Country, and to electrify them. While the process had been a slow one, it had been successful. It was unfortunate that the desire for municipalisation had prevailed at Birmingham, but still the company had given the people of Birmingham a vast amount of information, and he was glad to see that the Corporation of Birmingham was showing a disposition to deal with the matter seriously, and to give the company voluntarily all possible facilities for through communication.

The motion was seconded by Mr. EMILE GARCKE, and was carried.

Sir C. R. Wilson and Mr. J. S. Raworth (the retiring directors) were re-elected, and Messrs. Deloitte, Dever, Griffiths & Co., were appointed auditors to the company for the year.

At an extraordinary meeting held at the close of the general meeting, the directors were empowered to issue second debenture stock.

South Lancashire Electric Traction and Power Co.

THE preference and ordinary shareholders have received circulars explaining a scheme for changing the denomination of their holdings, in order to facilitate the raising of capital required to construct a further 36 miles of tramways. The works, up to the present time, have been largely constructed with debenture capital, and the company find great difficulty in raising further money for the construction of the additional tramways to complete the trunk lines. The board, after conferring with some of the large stockholders, propose a re-arrangement of the capital of the company, in the following terms:—

(*a*) The present debenture stockholders to accept 100 £1 5 per cent. first cumulative preference shares and 15 £1 ordinary shares for each £100 of debenture stock now held by them. (*b*) The present preference shareholders to become holders of 6 per cent. second cumulative preference shares, and to receive five £1 ordinary shares for every 100 preference shares now held by them in satisfaction of their arrears of dividend to December 31st, 1903. (*c*) A new 4 per cent. terminable debenture stock to be issued under the borrowing powers of the company to provide the money for building the additional 36 miles of tramways and other purposes.

The present position of the capital and debenture stock of the company is as follows:—600,000 6 per cent. cumulative preference shares of £1 each, of which 101,132 have been issued; 250,000 ordinary shares of £1 each, of which the whole have been issued; £750,000 4½ per cent. first mortgage debenture stock, of which has been issued, or is about to be issued, an amount not exceeding £560,000. On the completion of the proposed re-arrangement, the position will be as follows:—£850,000 5 per cent. cumulative first preference shares of £1 each; £150,000 6 per cent. cumulative second preference shares of £1 each; 250,000 ordinary shares of £1 each; and the borrowing powers of the company under the articles of association will amount to £1,250,000, being equivalent to the whole of the share capital. It is part of the arrangement that only 600,000 £5 per cent. cumulative first preference shares be issued, and no more capital be issued to rank in priority to or *pari passu* with such shares, and not more than £600,000 be raised under the borrowing powers of the company without the consent of the holders of £5 per cent. cumulative first preference shares thereto respectively.

Thomas Parker, Ltd.

THE ninth annual meeting was held on Monday at Wolverhampton Alderman C. T. Mander presiding.

The CHAIRMAN, in moving the adoption of the report, said the company had been working for nine years, and during that time a sound and stable business had been built up, and a large amount had been paid in dividends—equal to 66 per cent. of the share capital—whilst 60 per cent. of the earnings had been placed to the reserve fund, depreciation account and maintenance. These were sufficient indications that the British electrical trade had been worth fighting for in these days of competition and small profits. The last two years had needed careful thought and considerable changes in method to enable the company to hold its own. The problem that had had to be considered was how to cut away all unnecessary material and reduce the cost of production, and still to produce, if possible, a machine that was as good electrically and mechanically as the old ones, and thereby not lose the company's reputation for good work. That point had been reached, and the

company had been "going" for the new design for all it was worth. He would point out that it had meant a large amount of energy internally, which would not show until later balance-sheets. With regard to the consumer, the present day dynamo, whether built in England or abroad, was a better and cheaper machine than it would have been had the fight not taken place. Things were now settling down, and they knew where they were. There was a prospect of plenty of good work to go all round. The company was more than full of orders, and they had every reason to congratulate themselves.

Mr. ARMISTEAD seconded the motion.

A SHAREHOLDER wished to know why the company had three joint managers. The directors had stated that they had pleasure in submitting their report, but he failed to see where the pleasure came in in face of the balance-sheet.

The CHAIRMAN, in reply, said the three managers were of different calibre, and each had a different department. The board of directors had no experience of electrical machinery, and they trusted entirely to their managers. He hoped that the next dividend would be equal to previous ones.

The report was afterwards adopted, and then a dividend of 6 per cent. was declared.

Alderman Mander was re-elected a director, and the auditors, Messrs. Allen Edwards & Smith, were re-elected.

National Telephone Co.

THE report of the directors for the half-year ending June, 1903, to be submitted to the meeting to be held at Hamilton House, Victoria Embankment, E.C., on Thursday, July 23rd, says:—"The income accrued in respect of the business of the half-year amounts to £894,046 15s. 4d. as compared with £823,243 4s. 3d. for the corresponding period of 1902, being an increase of £70,803 11s. 1d. The working expenses for the half-year amount to £516,052 0s. 7d., as compared with £478,031 16s. 10d. for the corresponding period of 1902, being an increase of £38,020 3s. 9d. The net result for the half-year (after deducting the Post Office Royalties amounting to £81,930 8s.) is a profit balance of £296,064 6s. 9d., as compared with £269,445 8s. 3d. for the corresponding period of 1902, being an increase of £26,618 18s. 6d. The rentals carried forward for unexpired terms of running contracts amount to £874,383 1s. 10d., as compared with £821,397 12s. 8d. at the corresponding period of 1902, being an increase of £52,985 9s. 2d. Out of the available balance of £239,748 5s. 2d. shown by the net revenue account (No. 3) the board recommend the payment for the half-year of a dividend at the rate of 6 per cent. per annum on the first and second preference shares, 5 per cent. per annum on the third preference shares, 6 per cent. per annum on the preferred stock, and 5 per cent. per annum on the deferred stock, less income-tax in all cases. The board also propose to transfer £85,000 to the reserve fund, and to carry forward the balance of £5,731 11s. 10d. The sum of £334,115 19s. 11d. has been expended on capital account during the half-year in the erection of 14,606 additional exchange and private stations, and in the construction of underground works. At the general meeting four directors retire, and being eligible, offer themselves for re-election, viz., Sir Henry Fowler, M.P., Mr. George Franklin, Sir Wm. Cuthbert Quilter, Bart, M.P., and Mr. Wm. Alexander Smith."

Electric Construction Co.

THE tenth annual general meeting of this company was held on Thursday of last week at Winchester House, Mr. J. W. Barclay in the chair.

The CHAIRMAN, in moving the adoption of the report, said that the results submitted to the meeting in the annual accounts were satisfactory, considering the conditions of business during the year. The net profit of £20,736 19s. 9d. compared favourably with that of last year, and enabled them to recommend the same dividends and appropriations. A large amount was carried forward. The respective figures in the profit and loss account were approximately the same as last year, excepting in two instances. The expenditure for branch offices and foreign agencies was increased by £1,203 9s. 9d. The increase arose from the keener competition and the greater consequent necessity of keeping in touch with present and prospective customers. Then, an additional sum of £740 had been charged to the maintenance of plant, and went to show that their profit had not been maintained by allowing the plant to run down. Fortunately the increase on the expenditure side of the account was set off by larger increases of income. They would observe that the revenue from the Madras electric tramways had increased by £1,736 3s. 3d., and that the return from shares of other companies had improved by £627 19s. 11d. The latter was due to the higher dividend from the Electrical Power Storage Co., which they would recollect was originally an offshoot from their company. The two enterprises he had named now yielded a satisfactory return on the money invested, and both gave promise of still better things in the future, but they desired to restrict their operations to their own immediate business—that of manufacturing electrical machinery—and intended to take steps before another year to realise in whole or in part those outside investments. If they succeeded as they expected they would, the result would show important changes in the accounts. Turning to the balance-sheet, he said that it was satisfactory to point out that the expenditure on additions to their factories had been within narrow limits, and it was hoped that the capital outlay would be further diminished in coming years. Their works at Bushbury might now be considered complete, for they enabled them to cope with existing or prospective demands for any description or size of electrical plant of the kinds they manufactured. The smaller tools in the workshops were being renewed and replaced by others of the latest type, and thus they kept themselves abreast of the times in labour-saving appliances. Such tools were dealt with as "maintenance," and charged against revenue. He was confident that they would join with the directors in their high appreciation of the efforts of the management, engineering staff and artisans, which had achieved the satisfactory results he had explained in face of the keen competition experienced during the year, and in congratulating them on their success. They would also, he was sure, cheerfully approve their recommendation to distribute among them the usual bonus, which depended on the amount of dividend paid on the ordinary shares. The directors believed they possessed the confidence of the staff and employés of the company, and they heartily reciprocated the same, confident as they were, that all co-operated zealously and heartily in promoting the company's success. In that connection the shareholders would be pleased to know that the compensation for accidents to workmen during the year had been only £13 6s., and that if the compensation had been restricted to that provided by the Act, it would have been less than a sovereign. They would probably expect to learn something of their views on the company's prospects, and what effect the suggested new fiscal policy, which had suddenly become a burning question, might be expected to have on the business of the company, especially as the manufacture of electrical plant would, it was alleged, be among the first of their industries doomed to perish unless the fiscal policy of the last half century was modified. Well, he would tell them frankly that they did not like the competition of foreigners; he did not know anyone who did. It might, however, be a disagreeable medicine that stimulated the system. In any case their accounts showed that they still survived, although they had passed through, what he believed had been as severe a struggle with foreign competitors as they might reasonably expect to have to encounter in the future. The Germans had pushed hard, and secured orders from some corporations who preferred the cheapness of goods made in Germany, to the higher quality of British manufacture, but they were satisfied that the Germans had made no profit on their business in this country. It was not prosperity that sent them to this country, but the depression that had now for some years prevailed in Germany. The Germans considered that their loss would be less in selling at unremunerative prices in this country than if they allowed their works to stand idle. When they had better trade at home, and when the factories unhealthily stimulated by their protective policy had been eliminated, they would have little to fear from Germam competition. Again, the American manufacturers did not seem to find much advantage from protection, for although, as they were frequently told, they had unbounded natural resources at home, two of the largest companies had come across and established works in this country. No protective tariff would help them against such competition. This success must depend on their business management, and on the skill and ability of their engineering staff. It was to be hoped that the great development they foresaw in the use of electric power would provide work and a living for them all. In his opinion their industries had suffered more from legislative interference and restrictions and from the mistaken notions of those who thought they were furthering the interests of the working man, than from foreign competition. A recent case would illustrate that statement. The London County Council the other day resolved to accept the cheapest tenders for their work, whether from home or foreign manufacturers. So far there might not be much to complain of. But then the London County Council stipulated that every contractor should observe the trade union rate of wages and hours, and that the rates of wages should be published publicly in the workshops. Now those conditions were enforced against manufacturers in this country, but they were not, and could not be, enforced against the foreign contractor. The conditions were presumably intended to prevent sweating by employers, but the result to their artisans was that work they should naturally have went out of the country, because he need hardly tell them the interference between employers and their workmen, unnecessary, certainly, in their case, tended to raise friction in the factory, which employers strove to avoid, and indirectly added considerably to the cost and the risk of manufacture. Thus an interference, no doubt intended for the benefit of the workmen, reacted to their disadvantage, besides crippling the industries of the country. If that was Free Trade, it was an aspect of it which ought certainly to be the subject of inquiry. In conclusion, he would say that although they did not like foreign competition, they did not believe that the doom of their manufacturing interests was to come from foreign competition. No one could foresee what might arise from day to day, or predict the future in a business such as theirs, but, speaking for himself, to the best of his judgment, the company was at present in a stronger position than ever it had been, and he was glad to say that he had greater confidence in the future of the company than at any time since he had been connected with its management.

The motion was seconded by Mr. PHILIP E. BEACHCROFT and carried.

Telegraph Construction and Maintenance Co., Ltd.

SIR ROBERT HERBERT presided at the half-yearly meeting held at the offices on July 14th. He said that they had felt in a position to offer an interim dividend which he thought would be an acceptable

one. As he stated at the February meeting, the year had been one of hard work, and they had since completed the second of their great cable constructions across the Pacific—that which had been carried out for the Commercial Co. from Honolulu to Manila. This considerable work was completed, to the great satisfaction of the U.S. Government, on July 4th, Independence Day. The cable was quite equal in its character and performance to those which the company had been in the habit of laying in other places. It was about 5,800 knots, and it brought up the company's record, since its formation, to no less than 175,000 miles of deep-sea cable, and as much as 200,000 knots of insulated gutta-percha covered wire for the purpose of submarine telegraphy. They were not altogether sorry at not being oppressed at the moment with so great an amount of work as during the past two years. Their factory, which was steaming night and day, had, like a great ship, to occasionally go into dock and be overhauled. It would be an advantage during a comparatively quiet period, to be able to carry out certain alterations and extensions which had been contemplated for some time. They had an amount of current work which would carry them on through a considerable part of the present year. The prospects of cable construction generally were not bad, although there was perhaps nothing on immediately of a great scale. There seemed to be a tendency to have more and more cable communication between different points and ports, and the company were not at all interfered with in regard to their prospects by the aerial telegraph system, because the conviction seemed to be growing stronger and stronger that it could not compete for the purpose at any long distances more particularly with the cable. Consequently, the shares of the cable companies had risen very materially from the low position to which they had fallen, and he thought that on the whole the prospects of submarine telegraphy were quite good.

A vote of thanks closed the meeting.

Prospectuses.

The Charing Cross and Strand Electricity Supply Corporation has this week been inviting applications for an issue of 40,000 "City Undertaking" £4½ per cent. cumulative preference shares (1903), of £5 each at par. The list closes to-day, Friday.

The Havana Electricity Co. is also before the investing public until Monday next, July 20th, with an issue of £150,000 in £10 shares. A balance of similar amount is left for future issue. The company has an electric light and power concession for the city for 99 years. The plant now contracted for is designed to furnish current for more than 50,000 lamps. Messrs. Livesey, Son and Henderson, 14, South Place, E.C., are the consulting engineers.

The Isle of Wight Electric Light and Power Co., whose nominal share capital is £100,000 in ordinary and preference shares of £5 each, also £50,000 in 4½ per cent. debentures, are before the public until to-day, Friday, with an issue of the whole of the preference shares and debentures. Of the ordinary shares 9,993 have been applied for by and issued to Edmundson's Electricity Corporation. The company has powers for electric lighting at Ryde, Newport, Ventnor, Sandown, Shanklin, Cowes, and East Cowes, and three out of the four proposed generating stations have already been erected and opened, these being located at Ventnor, Sandown, and Newport. The Ryde station will be completed in the course of a few months. The prospectus appears among our advertisements to-day.

The financial press says that an important public issue in connection with the Manchester and Liverpool Electric Express Railway Co. is to take place this week.

St. James's and Pall Mall Electric Light Co.—The transfer books will be closed from 18th to 31st inst. inclusive.

Stock Exchange Notices.—Application has been made to the Committee to appoint a special settling day in and to grant a quotation to the County of London and Brush Provincial Electric Lighting Co., Ltd.—£250,000 4½ per cent. second debenture stock.

The Committee has also ordered the undermentioned to be quoted in the Official List:—Charing Cross and Strand Electricity Supply Corporation, Ltd.—Further issue of £49,712 4 per cent. debenture stock (redeemable).

Globe Telegraph and Trust Co.—The directors announce a quarterly dividend of 3s. each on the preference shares and 2s. each on the ordinary shares.

City and South London Railway Co.—The accounts for the half-year ended June 30th show a balance, after providing for the debenture stock interest, the payment of the dividend on the preference stocks, and the transfer to the renewal fund of £1,500, sufficient to allow the payment of a dividend on the consolidated ordinary stock for the half-year at the rate of 2¾ per cent. per annum, carrying forward a balance of £1,500. The dividend for the corresponding period last year was at the rate of 3 per cent. per annum, carrying forward a balance of £1,749.

STOCKS AND SHARES.

Wednesday Evening.

Again has it come about that the Stock Exchange waits upon politics, and the investment markets are influenced to no small extent by the march of events in the Far East. Money is fairly cheap, although the drain of gold to the Continent looks as though it would increase rather than the reverse. The eccentricities of the American Railway section afford a minor factor, but speculation in anything has fallen to so low an ebb on this side of the Atlantic that rumours of panic in New York, with their inevitable contradictions, exert a merely transitory effect. The markets with which we deal are all in a healthy condition, and the changes continue to be chiefly in the upward direction.

In spite of the enervating character of the weather and the time of year, several new electrical issues are appealing to the public. The long-expected offer of new Charing Cross and Strand City Undertaking Preference shares has at last appeared. In fixing the price of issue at par, *i.e.*, £5, the sponsors are taking a bold step, inasmuch as the present City Undertaking shares can be bought at 4⅛ in the market. The issue, however, is underwritten at a commission of 5 per cent., so that the underwriters really get their proportion for 4¾, at which price the shares look reasonably cheap. An evening contemporary amusingly remarks that "the quotation for the existing Preference shares is about 5¾." The newspaper in question must surely be confusing Charing Cross Preference shares with the City Undertaking issue.

No market has yet been made in the New Havana Electric shares. The company's prospectus is backed by names of high standing, and the concern has a wide scope for its operations. The Isle of Wight prospectus appealed to a more restricted class, and the shares will probably command a large local following to the traditional good management usual to the Edmundson's "babies;" this latest offspring should have a fine future in front of it.

As regards changes in the electricity supply list, City of London Ordinary are down 5s., the amount of the deducted dividend, while the Preference have recovered their 6s. distribution. County Preference relapsed ½ the other day, but otherwise the share list is practically the same as it was a week ago. Amongst Debentures a fall of a point in Edmundson's is more than accounted for by the quoting of the price *ex* the dividend of 2¼ per cent. taken off on the Stock Exchange pay-day.

Home Railway dividends are already upon us, but the market remains strangely apathetic. How quiet business in Home Railway descriptions is can be gauged from the fact that the Electrical Railway stocks are all but motionless on the very eve of the announcements; but City and South London has lost a couple of points upon the declaration of the dividend. Of course, the Tubes benefited very considerably in the June of 1902 from preparations for the Coronation festivities, and the "takes" of the last six weeks go against others which were swollen by country visitors.

The general impression is that the Central London will stick to its steady 4 per cent., but that there may be a pleasant surprise in store for the Waterloo and City stockholders. If the 3½ per cent. of the last half of 1902 can be repeated, the line will enter the progressive list; but it must be admitted that the present price of par seems to discount future possibilities to the tune of a 3½ per cent. dividend, at least. The new Mono-Rail prospectus is expected immediately.

Telegraph securities present a firm front, and there are rises all along the line. Eastern Extension shares have moved up to 12, and the price is less 2s. 6d. dividend as well. Eastern Telegraph Ordinary is again 1 per cent. higher, and several of the prior stocks have improved to the same extent. Western Telegraphs are up ¼, and Cuba Preference at 16½ have added the fraction to their price. The Anglo-American group is steady, without quotable change, but Globe Preference are another 10s. harder on the generally better tone of the market. Perhaps it is at last becoming inborne upon Telegraph shareholders that the Marconi competition cannot affect them for another quarter of a century, at all events. West African Telegraph shares are up to 5, and African Direct Debentures moved up to either side of 100. Telephone issues exhibit no feature beyond a rise in the Second Preference shares, but Telegraph Constructions are a shade easier, allowing for the dividend; British Electric Tractions do not alter, and London United Tramways Preference keep in the near neighbourhood of £12 per share.

Direct United States Cable Co.—The board recommends a final dividend of 3s. per share and a bonus of 1s. per share (both free of income-tax), making a total distribution of 3½ per cent. for the year ended June 30th last, and after placing £8,000 to reserve fund account, carrying forward a balance of about £2,693. The transfer books will be closed from July 14th to 28th.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1900.	1901.	1902.	Closing Quotations July 8th.	Closing Quotations July 15th.	Business done week ended July 15th, 1903. Highest	Lowest
67,100	African Direct Telegraph, 4 % Debs.	100	..	..	..	97 —102	98 —102	99½	..
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	..	..	..	2¼— 3¼	2¼— 3¼	..	..
119,700£	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	..	..	..	70 — 80	70 — 80	..	..
788,840	Anglo-American Telegraph	Stock	3½%	61s.	60/6	47 — 50	47 — 50	..	..
3,105,580	Do. do. do. 6 % Pref.	Stock	6 %	6 %	6 %	92 — 94	92 — 94	93	92⅜
3,105,580	Do. do. do. Deferred	Stock	5s. %	2s.	1/-	8¼— 8¾	8¼— 8¾	8 7/16	8 5/16
44,000	Chili Telephone, Nos. 1 to 44,000	5	5 %	5 %	6 %	4¾— 5¼	4¾— 5¼	..	..
13,333,300$	Commercial Cable	$100	8 %	8 %	8 %	150 —160	150 —160	..	..
1,841,269	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	..	..	..	89 — 93	91 — 94	93	91½
16,000	Cuba Telegraph	10	4½%	4 %	6½%	6¼— 7¼	6¼— 7¼	..	..
6,000	Do. 10 % Pref.	10	..	..	..	15½— 16½	16 — 17	..	..
12,931	Direct Spanish Telegraph	5	4 %	4 %	4 %	2¾— 3¼	2¾— 3¼	..	..
6,000	Do. do. 10 % Cum. Pref.	5	..	..	..	7 — 8	7 — 8	..	..
80,000	Do. do. 4½ % Debs.	50	..	..	..	97 —101	97 —101	..	..
60,710£	Direct United States Cable	20	3½%	3½%	3½%	9¾— 10¼	10 — 10½	10¼	..
87,800	Direct West India Cable, 4½% Reg. Deb., within Nos. 1 to 1,200, Red.	100	..	..	..	98 —101	98 —101	..	..
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	7 %	125 —130	126 —131	129¾	127¾
1,955,565	Do. 8½ % Pref. Stock	100	..	..	..	88 — 91	88 — 91	90	..
1,534,645	Do. 4 % Mort. Deb. Stock Red.	Stock	..	..	..	104 —107	105 —108	106	105¾
800,000	Eastern Extension, Australasia, and China Telegraph	10	7 %	7 %	7 %	10¾— 11¼	10¾— 11¼	12 3/16	11⅛
820,000£	Do. 4 % Deb. Stock	Stock	..	..	..	105 —108	105 —108	106¼	..
800,000	Eastern & South African Tele., 4% Mt. Db., Nos. 1 to 8,000, red. 1909	100	..	..	..	99 —102	99 —102	..	..
200,000£	Do. do. 4 % Reg. Mort. Debs. (Mauritius Sub.) 1 to 8,000	25	..	..	..	99 —102	101 —104 %	..	..
180,227	Globe Telegraph and Trust	10	5½%	5½%	..	8¾— 9	8¾— 9	8 13/16	8¾
180,042	Do. do. 6 % Pref.	10	..	..	..	12¼— 12¾	12¾— 13¼	12⅝	12¼
150,000	Great Northern Telegraph, of Copenhagen	10	15 %	15 %	12½%	22 — 23	22 — 23	..	..
62,500£	Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	..	..	..	98 —101	98 —101 xd	..	..
17,000	Indo-European Telegraph	25	10 %	10 %	10%	35 — 39	35 — 39	36½	..
100,000£	London Platino-Brazilian Telegraph, 6 % Debs.	100	..	..	..	100 —104	100 —104	..	..
1,983,333	National Telephone, Pref. Stock	100	5 %	5 %	6 %	102 —104	102 —104	104	102⅝
1,966,667	Do. do. Def. Stock	100	..	..	4½%	82 — 84	82 — 84	82⅞	82½
15,000	Do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	13 — 14	13 — 14	..	..
15,000	Do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	12 — 13	12½— 13½	13	..
2,250,000	Do. do. 5 % Non-cum. 3rd. Pref., 1 to 250,000	5	5 %	5 %	5 %	5 — 5¼	5 — 5¼	..	..
000,000£	Do. do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	96 — 98	96½— 98	97½	96½
600,000	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	101 —103	102½—103	..	..
171,504	Oriental Telephone and Elec. Nos. 1 to 171,504, fully paid	1	6 %	6 %	6 %	1 3/16— 1 5/16	1 3/16— 1 5/16	..	..
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000	100	..	..	..	97 —100	97 —100	..	..
11,889	Reuter's	8	5 %	5 %	..	6¼— 7⅛	6¼— 7⅛	..	..
3,303	Submarine Cables Trust	Cert.	..	..	..	113 —118	112 —117	..	..
68,000	United River Plate Telephone	5	7 %	7 %	7 %	5¼— 6	5¼— 6 xd	..	..
40,000	Do. do. 5 % Cum. Pref., Nos. 1 to 40,000	5	..	..	..	4¾— 5¼	4¾— 5	..	..
179,947£	Do. do. 5 % Debs.	Stock	..	..	..	103 —105	103 —106	103⅝	..
15,609	West African Telegraph, Shares	10	..	..	2 %	4 — 5	4¼— 5⅛	4⅜	..
150,000£	West Coast of America, 4% Debs., 1 to 1,500 guar. by Braz. Sub. Tel.	100	..	..	..	93 — 95	93 — 96	..	..
267,980	Western Telegraph, Ltd., Nos. 1 to 207,980	10	7 %	7 %	..	11¼— 11⅝	11⅞— 11¼	11⅞	11 7/8
75,000£	Do. do. 5 % Debs. 2nd series, 1906	100	..	..	..	100 —103	100 —103	..	..
400,000	Do. do. 4 % Deb. Stock Red.	100	..	..	..	95 — 98	97 —100	99	..
88,321	West India and Panama Telegraph	10	1½%	..	..	¾— ⅞	¾— ⅞	..	..
84,553	Do. do. do. 6 % Cum. 1st Pref.	10	..	..	..	6 — 6¼	6 — 6¼	..	..
4,669	Do. do. do. 6 % Cum. 2nd Pref.	10	..	..	..	3 — 4	3 — 4	..	..
80,000£	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	..	..	..	97 —100	97 —100	..	..

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

20,000	British Aluminium 7 % Cum. Pref.	10	..	..	..	3 — 4	3 — 4	..	..
800,000£	Do. do. 5 % 1st Mort. Deb. Stock Red.	Stock	..	..	..	74 — 79	75 — 80	78	77½
100,000	British Electric Traction	10	9 %	9 %	8 %	12¾— 13½	12 — 12½ xd	13	12
100,000	Do. do. 6 % Cum. Pref.	10	..	..	..	11¾— 12¼	11¾— 12⅝	12⅝	12 1/8
600,000£	Do. do. 5 % Perpetual Debenture Stock	Stock	..	..	..	122 —125	122 —125	124½	123¾
100,000	British Insulated and Helsby Cables	5	15 %	10 %	10 %	6¾— 7¼	6¾— 7¼	..	..
100,000	Do. do. 6 % Cum. Pref.	5	..	..	..	5¾— 6	5¾— 6	..	..
50,000	Do. do. 4½ % 1st Mort. Deb. Red.	100	..	..	..	101 —105	102 —106	..	..
50,000	¶Browett, Lindley & Co., Ord.	£1	8 %	Nil	..	5/16— 7/16	5/16— 7/16	..	..
50,000	¶ Do. do. 6 % Cum. Pref.	£1	6 %	6 %	..	14/6 to 15/6	14/6 to 15/6	..	..
105,731	Brush Electrical Engineering, Ord., 1 to 105,731	2	5 %	Nil	Nil	¾— 1¼	1— 1¼	..	..
150,000	Do. do. Non-cum. 5 % Pref.	2	6 %	3 %	6 %	1¼— 1¾	1¼— 1¾	..	..
125,000£	Do. do. 4½ % Perp. Deb. Stock	Stock	..	..	..	99 —102	99 —102	..	..
125,000£	Do. do. 4½ % Perp. 2nd Deb. Stock	Stock	..	..	..	87 — 92	87 — 92	..	..
35,000	Callender's Cable Construction shares	5	15 %	20 %	15 %	11½— 12½	11½— 12½	..	..
40,000	Do. do. do. 5 % Cum. Pref.	5	..	..	..	5¾— 6	5¾— 6	..	..
90,000£	Do. do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	..	..	..	106 —110	106 —110	..	..
1,860,014	Central London Railway, Ord. Stock	Stock	..	4 %	4 %	104 —107	104 —107	105½	104¾
494,093	Do. do. 4 % Pref. Stock	Stock	..	4 %	4 %	101 —104	101 —104	103¼	103¼
494,993	Do. do. Def. do.	Stock	..	4 %	4 %	107 —110	107 —110	108⅝	..
1,330,000	City and South London Railway	Stock	1½%	2 %	3½%	70 — 72	68 — 70	70½	68½
85,000	Crompton & Co., Nos. 1 to 85,000	5	5 %	7½%	..	2 — 2½	2 — 2½	..	..
100,000£	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 red.	..	..	..	..	101 —105	101 —105	..	..
99,261	Edison & Swan United Elec. Light, "A" shares, £3 paid, 1 to 99,261	5	2½%	Nil	..	0 —	0 — ⅛	..	..
17,139	Do. do. "A" shares, 01—017,139	5	2½%	Nil	..	1¼— 2½	1¼— 2½	..	..
344,023£	Do. do. 4 % Deb. Stock Red.	100	..	..	..	71 — 75	71 — 75	..	..
100,000£	Do. do. 5 % 2nd Deb. Stock Prov. Certs. all pd.	100	..	..	..	75 — 80	75 — 80	..	..
112,100	Electric Construction, 1 to 112,100	2	6 %	6 %	6 %	1⅝— 1⅞	1⅝— 1⅞	..	..
31,390	Do. do. 7 % Cum. Pref., 1 to 31,390	2	..	..	..	2½— 3	2½— 3 xd	..	..
82,500£	Do. do. 4 % Perp. 1st Mort. Deb. Stock	Stock	..	..	..	100 —103	99 —102 xd	..	..
25,000	General Electric Co. (1900), 5 % Cum. Pref.	10	5 %	5 %	..	9½— 10	9½— 10	..	..
200,000	Do. do. 4 % Mort. Deb.	Stock	..	..	..	99 —102	99 —102	..	..
35,000	Henley's (W. T.) Telegraph Works, Ord.	5	20 %	20 %	20 %	14 — 15	14 — 15	..	..
35,000	Do. do. 4½ % Pref.	5	4½%	..	..	5 — 5¼	5 — 5¼	..	..
48,050	Do. do. 4½ Mort. Deb. Stock	Stock	..	..	..	108 —112	108 —112	..	..
50,000	India-Rubber, Gutta-Percha & Telegraph Works	10	10 %	10 %	..	18½— 19½	18½— 19½	19	18⅝
800,000£	Do. do. 4 % 1st Mort. Deb.	100	..	..	..	100 —103	100 —103	..	..
37,500	†Liverpool Overhead Railway, Ord.	10	3½%	1½%	1½%	5⅜— 6	5⅝— 5⅞	..	..
10,000	† Do. do. Pref. £10 paid	10	..	..	..	10¼— 11¼	10¾— 11	..	..
37,350	Telegraph Construction and Maintenance	12	17½%	20 %	20 %	33 — 36	32 — 35 xd	34½	33½
150,000£	Do. do. 4 % Deb. Bds., Nos. 1 to 1,500 Red. 1909	100	..	..	..	100 —103	100 —103	101	..
540,000£	Waterloo & City Railway, Ord. Stock	100	3 %	3 %	3½%	98 —101	98 —101	..	..

† Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. ¶ From Manchester Share List.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

National Electric Free Wiring, ⅜—½.

Oldham, Ashton, and Hyde Electric (£10 pd.), Ord., 14½—14¾.
Do. do. Pref. (£10 pd.), 10—10½.

Bank rate of discount 3 per cent. (June 18, 1903).

SHARE LIST OF ELECTRICAL COMPANIES (*continued*).—ELECTRICITY SUPPLY COMPANIES.

Present issue.	NAME.	Stock or Share.	Dividends for the last three years. 1900.	1901.	1902.	Closing Quotations July 8th.	Closing Quotations July 15th.	Business done week ended July 15th, 1903. Highest.	Lowest
		‡							
100,000	Blackheath and Greenwich Dist. Electric Light, Ord.	£1	..	..	..	⅝ — ¾	⅝ — ¾	..	..
100,000	Do. 4½% 1st Deb. Stock, Prov. Certs.	100	..	..	..	118 —121	118 —121	..	..
20,000	Brompton & Kensington Electric Light Sup., Ord., 1 to 20,000	5	6 %	8 %	8 %	10¼— 11	10¼— 11	10¾	..
20,000	Do. do. 7 % Cum. Pref.	5	..	..	..	10¼— 10¾	10¼— 10¾	..	..
50,000	Charing Cross and Strand Electricity Supply	5	9 %	10 %	10 %	9 — 9⅛	9 — 9⅛	..	..
70,000	Do. do. 4½% Cum. Pref.	5	..	..	..	5⅛— 6	5⅛— 6	5⅞	5¾
40,000	Do. do. "City Undertaking" 4½% Cum. Pref.	5	..	..	..	4⅝— 5	4⅝— 5	4 15/16	..
250,000	Do. do. 4 % Deb. Stock Red.	100	..	..	..	104 —106	104 —106	..	..
44,436	*Chelsea Electricity Supply, Ord.	5	5¼%	4 %	4½%	6 — 6⅛	6 — 6⅛	..	..
150,000‡	Do. do. % Deb. Stock Red.	Stock	..	..	..	107 —110	107 —110	..	..
70,595	City of London Electric Lighting, Ord. 40,001—110,595	10	0 %	5 %	5 %	11⅜— 12½	11⅜— 12 xd	11 13/16	..
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	..	..	13 — 14	13 — 14 xd	13½	13 1/16
400,000‡	Do. 5 % Deb. Stock, Scrip. (iss. at 115) all paid	..	..	..	..	121 —126	121 —126	..	..
300,000	Do. 4½% 2nd Deb. Stock, Prov. Certs., all paid	100	..	..	..	102 —104	102 —105	..	..
40,000	County of London & Brush Prov. Electric Lighting, Ord. 1—40,000	10	4 %	4 %	4 %	8 — 9	8 — 9	8 13/16	8 11/16
20,000	Do. do. do. 6 % Pref., 40,001—60,000	10	..	..	..	12 — 13	11¼— 12½	12½	12
400,000‡	Do. do. 4½% Deb. Stock, Prov. Certs. (all paid) Red	..	..	..	..	109 —112	109 —112	110½	..
50,000	Edmundson's Electric Corporation, Ord. Shares	5	7 %	7 %	..	6¾— 7	6¾— 7	6 15/16	6¾
30,000	Do. do. 6 % Cum. Pref.	..	..	..	..	6 — 6⅛	6 — 6⅛	6 15/16	6⅞
140,000	Do. do. 4½% 1st Mort. Deb. Stock	100	..	..	..	108 —111	106 —109 xd	..	..
21,000	Kensington and Knightsbridge Electric, Ord.	5	12 %	10 %	10 %	11 — 12	11 — 12	..	..
90,000	Do. do. do. 4 % Debenture Stock	Stock	..	..	..	103 —106	103 —106	..	..
110,000	London Electric Supply Corporation, Limited, Ord.	3	..	..	..	2 — 2½	2 — 2½	..	..
49,840	Do. do. do. 6 % Pref.	5	..	..	..	5⅜— 6	5⅜— 6	5⅞	5 11/16
250,000‡	Do. do. do. 4 % 1st Mort. Deb. Stock Red	Stock	..	..	..	100 —102	100 —103	..	..
100,000	Metropolitan Electric Supply, 1 to 100,000	10	6 %	6½%	7½%	17⅛— 18½	17⅛— 18½	18 1/16	..
220,000‡	Do. do. 4½% 1st Mort. Deb. Stock	..	..	..	..	108 —112	108 —112	..	..
250,000‡	Do. do. 3½% Mort. Deb. Stock Red	Stock	..	..	..	97 —100	97 —100	..	..
10,852	Notting Hill Electric Lighting	10	7 %	6 %	6 %	13 — 14	13 — 14	..	..
40,000	St. James' and Pall Mall Electric Light, Ord.	5	14½%	14½%	14½%	15⅛— 16½	15⅛— 16½	15⅝	..
20,000	Do. do. do. 7 % Pref. 20,081 to 40,080	5	..	..	..	8⅛— 9⅛	8 — 9	..	..
150,000‡	Do. do. do. 3½% Deb. Stock Red	100	..	..	..	98 —101	98 —101	..	..
12,000	Smithfield Markets Electric Supply, Ord.	5	..	..	2½%	3 — 3⅛	3⅛— 4	..	..
65,000	South London Electricity Supply, Ord.	5	..	..	1½%	3⅛— 4	3⅛— 4	..	..
30,000	Urban Electric Supply, Ord.	5	..	..	..	5 — 5½	5 — 5½	..	..
30,000	Do. do. 5 % Cum. Pref.	5	..	..	..	5 — 5½	5 — 5½	5⅛	..
110,000	Westminster Electric Supply, Ord.	5	10½%	10½%	12 %	12 — 13	12 — 13	..	..
28,141	Do. do. 5 % Cum. Pref.	5	..	..	..	6¼— 6⅝	6¼— 6⅝	..	..

*Subject to Founders Shares. ‡Unless otherwise stated all shares are fully paid.

MARKET QUOTATIONS, Wednesday, July 15th.

CHEMICALS, &c.		Latest Price.	Week's Inc. or Dec.
a Acid, Hydrochloric	per cwt.	5/-	..
a ,, Nitric	per cwt.	22/-	..
a ,, Oxalic	per cwt.	32/-	..
a ,, Sulphuric	per cwt.	5/6	..
n Ammoniac, Sal	per cwt.	42/-	..
a Ammonia, Muriate (crystal)	per ton	£33 10	..
a ,, ,,	per ton	£30	..
a Bleaching powder	per ton	£4 10	..
n Bisulphide of Carbon	per ton	£15	..
a Borax	per ton	£13	..
a Benzole (90 %)	per gal.	7/-	..
a ,, (50/90 %)	per gal.	5/6	..
a Copper Sulphate	per ton	£19	..
a Lead, Nitrate	per ton	£24	..
a ,, White Sugar	per ton	£31	..
a ,, Peroxide	per ton	£27 10	..
a Methylated Spirit	per gal.	2/6	..
a Naphtha, Solvent (90% at 160° C).	per gal.	5/6	..
a Potash, Bichromate, in casks	per lb.	3d.	..
a ,, Caustic (75/80%)	per ton	£24	..
a ,, Bisulphate	per ton	£35	..
a Shellac	per cwt.	136/-	..
a Sulphate of Magnesia	per ton	£4 10	..
a Sulphur, Sublimed Flowers	per ton	£6 5	..
a ,, Recovered	per ton	£5 10	..
a ,, Lump	per ton	£5	..
a Soda, Caustic (white 70 %)	per ton	£10 15	..
a ,, Crystals	per ton	£3	..
a ,, Bichromate, casks	per lb.	2½d.	..
METALS, &c.			
b Aluminium Ingots, in ton lots	per ton	£130	..
b ,, Wire, in ton lots	per ton	£168	..
b ,, Sheet, in ton lots	per ton	£166	..
p Babbitt's metal ingots	per ton	£43 to £145	..
c Brass (rolled metal 2' to 12') basis	per lb.	7½d.	..
c ,, Tube (brazed)	per lb.	9d.	..
c ,, ,, (solid drawn)	per lb.	7½d.	..
c ,, Wire, basis	per lb.	7½d.	..
c Copper Tubes (brazed)	per lb.	9d.	..
c ,, ,, (solid drawn)	per lb.	9½d.	..
g Copper Bars (best selected	per ton	£71	..

METALS, &c. (*continued*).		Latest Price.	Week's Inc. or Dec.
g Copper Sheet	per ton	£71	..
g ,, Rod	per ton	£71	..
e ,, (Electrolytic) Bars	per ton	£67	..
e ,, ,, Sheets	per ton	£78	..
e ,, ,, Rod	per ton	£69	..
e ,, ,, H.C. Wire	per lb.	8½d.	..
f Ebonite Rod	per lb.	3/3	..
f ,, Sheet	per lb.	3/-	..
n German Silver Wire	per lb.	1/6	..
h Gutta-percha fine	per lb.	8/-	..
h India-rubber, Para fine	per lb.	4/- to 4/0½	inc.
i Iron, Charcoal Sheets	per ton	£18	..
i ,, Pig (Cleveland warrants)	per ton	46/2	3½d. dec.
i ,, Forgings, according to size	per ton	From £11	..
i ,, Scrap, heavy	per ton	47/6 to 50/-	..
i ,, Wire, galvanised No. 8	per ton	£9 15	..
g Lead, English Ingot	per ton	£11 15 to £11 17 6	..
g ,, ,, Sheet	per ton	£13 10	..
m Manganin Wire No. 28	per lb.	8/-	..
g Mercury	per bot.	£8 12 6	..
d Mica (in original cases) small	per lb.	4d. to 1/2	..
d ,, ,, ,, medium	per lb.	2/3 to 3/6	..
d ,, ,, ,, large	per lb.	3/9 to 7/9	..
p Phosphor Bronze, plain castings	per lb.	1/- to 1/2½	..
p ,, rolled bars & rods	per lb.	1/1 to 1/4	..
p ,, ,, strip & sheet	per lb.	From 1/2	..
o Platinum	per oz.	£4	..
p Silicium Bronze Wire	per lb.	10d. to 1/-	..
i Stee., Magnet, acc'd'g to desc'p'n	per ton	£58	..
i ,, ,, in bars		£15 to £40	..
g Tin, Block	per ton	£126 to £127	inc.
g ,, Foil	per lb.	1/8	..
n ,, Wire, Nos. 1 to 16	per lb.	1/7	..
p White Anti-friction Metals— "White Ant" brand	per ton	£42 to £65	..
j Yarns, 2/10s Grey Cotton, on sp'ls	per lb.	7½d.	..
j ,, 6 lea. Flax	per lb.	5⅝d.	..
j ,, 3 ply 10 lbs. Russian	per lb.	4 15/16d.	..
j ,, 10 lbs. Russian, single	per lb.	4½d.	..
j ,, 180 lbs. Jute rove	per ton	£11	..
k Zinc Sh't (Vieille Montagne bnd.)	per ton	£23 15	..

Quotations supplied by Messrs.—a G. Boor & Co.; b The British Aluminium Co., Ltd.; c Thos. Bolton & Sons, Ltd.; d F. Wiggins & Sons.; e Frederick Smith & Co.; f India-Rubber, G.P. and Teleg. Works Co., Ltd.; g James & Shakspeare; h Edward Hill & Co.; i Bolling & Lowe; j W. H. Hindley & Co. k Morris Ashby, Ltd.; m W. T. Glover & Co., Ltd.; n P. Ormiston & Sons o Johnson, Matthey & Co., Ltd.; p The Phosphor Bronze Co., Ltd.

ELECTRIC TRAMWAY AND RAILWAY TRAFFIC RECEIPTS.

	Locality.	Week ending	Receipts for the week. £	£*	Total to date. £	£*	Miles open.	*
	Aberdeen	June 27	1,247	— 48	4,864	+ 915	—	—
	Birmingham	July 11	5,125	—115	140,567	+ 6,452	—	—
	Bournemouth	,, 8	1,159	—	—	—	—	—
	Blackburn	June 26	909	—286	11,668	+ 674	12½	+1 1/2
	Blackpool	July 9	1,098	+102	12,316	+ 1,254	—	—
	Blackpool and Fleetwood	,, 13	811	+ 97	1,320	+ 149	7¾	—
	Bolton	,, 12	2,014	+403	28,822	+ 3,827	25	—
	Bradford	,, 12	4,025	+409	56.121	+11,615	39	+2
	Brighton	,, 12	982	— 21	66,444	—	6½	—
	Bristol	,, 10	5 086	— 65	—	—	28	—
	Burnley	,, 11	852	+ 68	—	—	—	—
B.E.T.	Barnsley District	,, 3	196	—	4,638	—	—	—
B.E.T.	Devonport	,, 3	515	+ 50	11,15	+ 341	5	—
B.E.T.	Dudley—Stourbridge	,, 3	941	+156	20,7?9	+ 2,125	18½	—
B.E.T.	Gateshead	,, 3	860	+ 54	22,247	+ 3 920	10½	+ ½
B.E.T.	Gravesend—Northfleet	,, 3	314	—	5,625	—	3½	—
B.E.T.	Greenock—Pt. Glasgow	,, 3	490	+ 32	13,329	+ 1,185	7½	—
B.E.T.	Hartlepool	,, 3	334	+ 19	6.541	+ 429	6½	+2
B.E.T.	Kidderminster	,, 3	166	+ 1	3,164	+ 178	4½	—
B.E.T.	Merthyr	,, 3	211	— 12	5,056	— 269	3	—
B.E.T.	Middleton	,, 3	425	+ 93	8,053	+ 747	8½	—
B.E.T.	Oldham—Ashton	,, 3	631	+ 44	14,798	+ 1,396	8	—
B.E.T.	Peterborough	,, 3	187	—	3,593	—	—	—
B.E.T.	Poole	,, 3	345	+ 36	7,215	+ 1,172	8½	—
B.E.T.	Potteries	,, 3	1 855	+166	40,605	+ 2,566	29½	—
B.E.T.	Rothesay	,, 3	251	+ 21	2,407	+ 867	—	—
B.E.T.	Sheerness	,, 1	119	—	1,150	—	—	—
B.E.T.	Southport	,, 3	362	— 20	7,426	+ 1,595	5½	—

	Locality.	Week ending	Receipts for the week. £	£*	Total to date. £	£*	Miles open.	*
B.E.T. Co.	South Staffordshire	July 3	1,035	+ 225	21,722	+ 1,407	21½	—¾
B.E.T. Co.	Swansea	,, 3	594	+ 12	12,567	+ 593	5½	—
B.E.T. Co.	Taunton	,, 3	70	— 1	1,464	— 116	1½	+1½
B.E.T. Co.	Tynemouth	,, 3	417	+ 24	7,271	+ 879	3½	—
B.E.T. Co.	Weston-super-Mare	,, 1	195	—134	1,848	— 289	2½	+2½
B.E.T. Co.	Wolverhampton Dist	,, 3	483	+ 275	10,0?7	+ 5,757	10½	+8
B.E.T. Co.	Wrexham	,, 3	148	—	1,918	—	—	—
B.E.T. Co.	Yorks. Woollen Dist.	,, 3	425	—	5,539	—	6	—
	Cardiff	,, 11	2,600	+1016	28,994	+10,715	—	—
	Dover	,, 11	377	+107	5,7?8	+ 124	3	—
	Dublin	,, 10	5,576	+373	7,788	+ 402	46	—
	East Ham	,, 11	743	+ 236	10,036	+ 3,238	5	+ ½
	Glasgow	June 6	15,376	+3194	15,376	+ 3,194	65	+13
	Hull	July 11	1,880	+ 74	27,023	+ 1,594	11	+ 1
	Ilkeston	,, 11	1	220	—	—	—	—
	Isle of Thanet	,, 11	1,175	+ 79	12,941	— 236	—	—
	Leeds	,, 11	5,560	+ 182	84,6 6	+ 5,520	—	—
	Liverpool	,, 4	11,121	+ 637	264,448	+10,361	101	+2½
	Manchester	,, 4	12,676	+ 7354	—	—	110	+85
	Newcastle	,, 11	3,285	+ 540	—	—	17	—
	Portsmouth	,, 4	2,188	—314	—	—	29	—
	Salford	June 29	4, 56	+637	47,129	+14,110	—	—
	Southampton	July 9	1,122	+ 31	—	—	—	—
	Sunderland	,, 12	1,328	+138	18,128	+ 727	20	+ 2
	Central London Railway	,, 11	6,924	+ 77	13,712	— 331	6	—
	Chatham & District Co.	,, 2	714	+204	12,543	+11,265	8½	—
	City and S. London Ry.	,, 12	2,473	— 913	4,928	— 679	6½	—
	Dublin and Lucan Elwy.	June 21	1?7	+ 16	2,513	+ 91	—	—
	Liverpool Overhead Ry.	July 12	1,718	+134	3,390	+ 211	6½	—

* Compared with the corresponding period of 1902.

MODERN VIEWS ON MATTER: THE REALISATION OF A DREAM.

BY SIR WILLIAM CROOKES, F.R.S., &c.

An Address delivered before the Congress of Applied Chemistry at Berlin, June 5th, 1903.

FOR nearly a century men who devote themselves to science have been dreaming of atoms, molecules, ultra-mundane particles, and speculating as to the origin of matter: and now to-day they have got so far as to admit the possibility of resolving the chemical elements into simpler forms of matter, or even of refining them altogether away into ethereal vibrations or electrical energy.

This dream has been essentially a British dream, and we have become speculative and imaginative to an audacious extent, almost belying our character of a purely practical nation. The notion of impenetrable mysteries has been dismissed. A mystery is a thing to be solved, "and Man alone can master the Impossible." There has been a vivid new start. Our physicists have remodelled their views as to the constitution of matter, and as to the complexity, if not the actual decomposability, of the chemical elements. To show how far we have been propelled on the strange new road, how dazzling are the wonders that waylay the researcher, we have but to recall—Matter in a fourth state, the genesis of the elements, the dissociation of the chemical elements, the existence of bodies smaller than atoms, the atomic nature of electricity, the perception of electrons, not to mention other dawning marvels far removed from the lines of thought usually associated with English chemistry.

The earliest definite suggestion in the last century of the possible compound nature of the metals occurs in a lecture delivered in in 1809* by Sir Humphry Davy at the Royal Institution. In that memorable lecture he speculated on the existence of some substance common to all the metals, and he averred that "If such generalisations should be supported by facts, a new, a simple, and a grand philosophy would be the result. From the combination of different quantities of two or three species of ponderable matter we might conceive all the diversity of material substances to owe their constitution."

Again, in 1811, he said† :—"It will be useless to speculate upon the consequences of such an advancement in chemistry as that of the decomposition and composition of the metals. . . . . It is the duty of a chemist to be bold in pursuit. He must not consider things as impracticable merely because they have not yet been effected. He must not regard them as unreasonable because they do not coincide with popular opinion. He must recollect how contrary knowledge sometimes is to what appears to be experience. . . . . To inquire whether the metals be capable of being decomposed and composed is a grand object of true philosophy."

Davy first used the term "radiant matter" about 1809, but chiefly in connection with what is now called radiation. He also used the term in another sense, and the following passage‡ in its clear forecast is prophetic of the modern electron:—"If particles of gases were made to move in free space with an almost infinitely great velocity—*i e*, to become radiant matter—they might produce the different species of rays, so distinguished by their peculiar effects."

In his lectures at the Royal Institution in 1816 "On the General Properties of Matter," another prescient chemist, Faraday, used similar terms when he said:—"If we conceive a change as far beyond vaporisation as that is above fluidity, and then take into account also the proportional increased extent of alteration as the changes rise, we shall, perhaps, if we can form any conception at all, not fall far short of radiant matter; and as in the last conversion many qualities were lost, so here also many more would disappear." Again, in one of his early lectures he strikes a forward note:—"At present we begin to feel impatient, and to wish for a new state of chemical elements. To decompose the metals, to reform them, and to realise the once absurd notion of transmutation are the problems now given to the chemist for solution."

A year later Faraday startled the world by a discovery to which he gave the title "On the Magnetisation of Light and the Illumination of the Magnetic Lines of Force." For 50 years this title was misunderstood, and was attributed to enthusiasm or confused ideas. But to-day we begin to see the full significance of the Faraday dream.

In 1879, in a lecture I delivered before the British Association§ at Sheffield, it fell to my lot to revive "Radiant Matter." I advanced the theory that in the phenomena of the vacuum tube at high exhaustions the particles constituting the cathode stream are not solid, nor liquid, nor gaseous, do not consist of atoms propelled through the tube and causing luminous, mechanic, or electric phenomena where they strike, "but that they consist of something much smaller than the atom,—fragments of matter, ultra-atomic corpuscles, minute things, very much smaller, very much lighter than atoms,—things which appear to be the foundation stones of which atoms are composed."‖

I further demonstrated that the physical properties of radiant matter are common to all matter at this low density. "Whether the gas originally under experiment be hydrogen, carbon dioxide, or atmospheric air, the phenomena of phosphorescence, shadows, magnetic deflection, &c., are identical." Here are my words, written nearly a quarter of a century ago:—"We have actually touched the borderland where matter and force seem to merge into one another*—the shadowy realm between the known and unknown. I venture to think that the greatest scientific problems of the future will find their solution in this borderland, and even beyond; here, it seems to me, lie ultimate realities, subtle, far reaching, wonderful."

The now generally accepted view that our chemical elements have been formed from one primordial substance was advocated in 1888 by me when President of the Chemical Society,† in connection with a theory of the genesis of the elements. I spoke of "an infinite number of immeasurably small ultimate—or, rather, ultimatissimate—particles gradually accreting out of the formless mist, and moving with inconceivable velocity in all directions."

Pondering on some of the properties of the rare elements, I strove to show that the elementary atoms themselves might not be the same now as when first generated—that the primary motions which constitute the existence of the atom might slowly be changing, and even the secondary motions which produce all the effects we can observe—heat, chemic, electric and so forth—might in a slight degree be affected; and I showed the probability that the atoms of the chemical elements were not eternal in existence, but shared with the rest of creation the attributes of decay and death.

Our minds are gradually getting accustomed to the idea of the genesis of the elements, and many of us are straining for the first glimpse of the resolution of the chemical atom. We are eager to enter the portal of the mysterious region too readily ticketed "Unknown and Unknowable."

Another phase of the dream now demands attention. I come to the earlier glimpses of the electric theory of matter.

Passing over the vaguer speculations of Faraday and the more positive speculations of Sir William Thomson (now Lord Kelvin), one of the earliest definite statements of this theory is given in an article in the *Fortnightly Review* for June, 1875, by W. K Clifford—a man who in common with other pioneers shared that "noblest misfortune of being born before his time." "There is great reason to believe," said Clifford, "that every material atom carries upon it a small electric current, *if it does not wholly consist of this current.*"

The idea of units or atoms of electricity—an idea hitherto floating intangibly like helium in the sun—can now be brought to earth and submitted to the test of experiment‡. Faraday, W. Weber, Laurentz, Gauss, Zöllner, Hertz, Helmholtz, Stoney, Sir Oliver Lodge, have all contributed to develop the idea—originally due to Weber—which took concrete form when Stoney showed that Faraday's law of electrolysis involved the existence of a definite charge of electricity associated with the ions of matter. This definite charge he called an electron. It was not till some time after the name had been given that electrons were found to be capable of existing separately.

In 1891, in my Inaugural Address as President of the Institution of Electrical Engineers,§ I showed that the stream of cathode rays near the negative pole was always negatively electrified, the other contents of the tube being positively electrified, and I explained that "the division of the molecule into groups of electro-positive and electro-negative atoms is necessary for a consistent explanation of the genesis of the elements." In a vacuum tube the negative pole is the entrance and the positive pole the exit for electrons. Falling on a phosphorescent body, yttria, for instance—a collection of Hertz molecular resonators—the electrons excite vibrations of, say, 550 billion times a second, producing ether waves of the approximate length of 5·75 tenmillionths of a millimetre, and occasioning in the eye the sensation of citron-coloured light. If, however, the electrons dash against a heavy metal or other body which

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* "Works of Sir Humphry Davy," Vol. viii., p. 325.

† *Loc. cit.*, Vol. viii., p. 330.

‡ *Loc. cit.*, Vol. viii., p. 349.

§ "British Associations Reports," Sheffield Meeting, 1879. *Chemical News*, Vol. xl., p. 91. *Phil. Trans. Roy. Soc.*, 1879, Part I., p. 585. *Proc. Roy. Soc.*, 1880, No. 205, p. 469.

‖ Sir O. Lodge, *Nature*, Vol. lxvii., p. 451.

* "Matter is but a Mode of Motion" (*Proc. Roy. Soc.*, No. 205, p. 472).

† Pres. Address to Chem. Soc., March 28th, 1888.

‡ "The equivalent weights of bodies are simply those quantities of them which contain equal quantities of electricity . . . . it being the electricity which *determines* the equivalent number, *because* it determines the combining force. Or, if we adopt the atomic theory or phraseology, then the atoms of bodies which are equivalents to each other in their ordinary chemical action, have equal quantities of electricity naturally associated with them."—Faraday's "Experimental Researches in Electricity," par. 869, January, 1834.

"This definite quantity of electricity we shall call the molecular charge. If it were known it would be the most natural unit of electricity."—Clerk Maxwell's "Treatise on Electricity and Magnetism," First Edition, Vol. i., 1873, p. 311.

"Nature presents us with a single definite quantity of electricity. . . . . For each chemical bond which is ruptured within an electrolyte a certain quantity of electricity traverses the electrolyte, which is the same in all cases."—G. Johnstone Stoney, "On the Physical Units of Nature," British Association Meeting, Section A, 1874.

"The same definite quantity of either positive or negative electricity moves always with each univalent ion, or with every unit of affinity of a multivalent ion."—Helmholtz, Faraday Lecture, 1881.

"Every monad atom has associated with it a certain definite quantity of electricity; every dyad has twice this quantity associated with it; every triad three times as much, and so on."—O. Lodge, "On Electrolysis."—*British Association Report*, 1885.

§ "Electricity in Transitu: from Plenum to Vacuum."—(*Journ. Inst. Electrical Engineers*, Vol. xx., p. 10, January 15th, 1891).

will not phosphoresce, they produce ether waves of a far higher frequency than light, and are not continuous vibrations, but, according to Sir George Stokes, simple shocks or solitary impulses; more like discordant shouts as compared with musical notes.

In the years 1893-4-5 a sudden impulse was given to electric vacuum work by the publication in Germany of the remarkable results obtained by Lenard and Röntgen, who showed that the phenomena inside the vacuum tube were surpassed in interest by what took place outside. It is not too much to say that from this date what had been a scientific conjecture became a sober reality.

In 1896 Becquerel, pursuing the masterly work on phosphorescence inaugurated by his illustrious father, showed that the salts of uranium constantly emit emanations which have the power of penetrating opaque substances, and of affecting a photographic plate in total darkness, and of discharging an electrometer. In some respects these emanations, known as Becquerel rays, behave like rays of light, but they also resemble Röntgen rays. Their real character has only recently been ascertained, and even now there is much that is obscure and provisional in the explanation of their constitution and action.

Following closely upon Becquerel's work came the brilliant researches of M. and Mdme. Curie, on the radio-activity of bodies accompanying uranium.

Hitherto I have been recounting isolated instances of scientific speculation with apparently little relation to one another. The existence of matter in an ultra-gaseous state; material particles smaller than atoms; the existence of electrical atoms or electrons; the constitution of Röntgen rays and their passage through opaque bodies; the emanations from uranium; the dissociation of the elements—all these isolated hypotheses are now focussed and welded into one harmonious theory by the discovery of radium.

> "Often do the spirits
> Of great events stride on before the events,
> And in to-day already walks to-morrow."

No new discovery is ever made without its influence ramifying in all directions and explaining much that before had been mystifying. Certainly no discovery of modern times has had such wide-embracing consequences, and thrown such a flood of light on broad regions of hitherto inexplicable phenomena, as this discovery of M. and Mdme. Curie and M. Pémont, who patiently and laboriously plodded along a road bristling with difficulties almost insuperable to others who, like myself, have toiled in similar labyrinths of research. The crowning point of these labours is radium.

(To be concluded.)

THE INCORPORATED MUNICIPAL ELECTRICAL ASSOCIATION.

Abstract of Address delivered at Sunderland on Wednesday, July 15th, by MR. JOHN F. C. SNELL, President.

I FEEL very deeply the honour which you have done me and this town in conferring upon me the office of president. As the opportunity comes but once, I have determined to speak boldly on some of the subjects which I feel are seriously menacing the progress of municipal undertakings.

On more than one occasion I have been told that our Association is feeble in its organisation, and has done little of importance during its existence. For my own part I must freely admit that I have received much help from these annual conventions, not only from the papers, but particularly from private discussions and visits to various works throughout the country. The *esprit de corps* and good feeling which is so noticeable at these conventions is a particularly pleasant phase of our Association.

The municipalisation of certain public necessaries—whatever may be the opposition offered by private interests—has become a settled policy of the present day. Among these is the supply of electricity, and it must be acknowledged that municipal electrical supply must be allowed free and wise expansion, and that unnecessary restrictions must be removed.

We shall agree, I think, that of all known means of transmitting energy, electricity has the right, *par excellence*, to the first position, and its wider use will help us to use the natural wealth of our land with increasing efficiency. I believe that at last English people have awakened from their lethargy, and it may be a surprise to many to see the evidence of rapid electrical developments on the Wear, Tyne, and Tees; and more surprising still when they are told that this has all sprung into being during the last two or three years. The effect upon trade output, I am convinced, will soon be noticed, and this will mean a new era of prosperity to our manufacturers.

But it is more particularly on the supply of electricity by municipalities that I wish to speak. To remove a false idea which has been circulated, viz., that electrical supply companies are much more progressive and are managed in a more businesslike way than municipal departments, let me briefly recite what was the actual comparison for 1902 between these two classes of undertakings. The total capital outlay on company undertakings in the Metropolis in 1902 was £9,299,000, and on undertakings owned by local authorities £1,448,000. The average capital expenditure per kilowatt installed in the former was £115, and in the latter £96·5. The average price per unit sold in the former was 4·72d., and in the latter 3·58d.; whereas the cost per unit sold was 2·59d. in the former, and 2·38d. in the latter: which means that Metropolitan companies spent 19 per cent. more on plant, charged 32 per cent. more for each unit sold, and their costs were nearly 9 per cent. more than the local authorities.

And the same is true of the provincial undertakings. In the provinces the companies had spent £2,963,000, and the local authorities £13,404,570. The average capital expenditure per kilowatt installed in the former was £98·5, and in the latter £78·5; the average price per unit sold in the former was 4·45d., and in the latter 3·15d. The companies spent 25 per cent. more on plant, charged 41 per cent. more per unit, and their costs were nearly 34 per cent. in excess of the costs of the municipal undertakings. This, surely, sufficiently answers the attacks which have been made upon municipal electrical undertakings during the last year.

The most important and most debated question at the present moment is that of depreciation of municipal electrical undertakings. A great deal of this controversy about depreciation arises from the wilful neglect of our critics to make a *just* comparison between companies and municipalities, and also I think by a confusion between "wear and tear" and "antiquation." I think it better to at once make this point clear. For example: a boiler will require certain repairs from year to year; new tubes, new parts of certain fittings, new furnace tubes, perhaps, or other renewals dependent on the type. This I call "wear and tear," and such renewals are properly paid for from revenue. But in addition there is a gradual deterioriation of the boiler itself right through—a process of decay, as it were—and like ourselves it has a life dependent on two things: its original manufacture, and its usage during life! This deterioriation I call "antiquation" or true depreciation. There is yet a third factor not to be forgotten, but I think easily disposed of, viz., the possibility of certain details of plant becoming obsolete. I do not call the replacement of small sets—rendered necessary during the pioneering stages of any concern—by larger and more economical sets "obsolescence," for the smaller sets will fetch their present value when sold, and thus no waste of capital takes place—at least this is my personal experience, from which I generalise. We are left then with two other factors, viz., "wear and tear" and "antiquation" (or true depreciation). The first is met by revenue, and is thus safely dismissed from this argument; but antiquation remains. We must look squarely at this fact. Some of the plant in both electricity and tramway concerns has a shorter life than the 25 or 30 years allowed by the Local Government Board—some a much longer. The period for the repayment of these loans is one which requires alteration. I will first recite some of the anomalies which exist. The London County Council is enabled to grant periods of 42 years to the borough councils. The Commissioners for Scotland allow a period of 30 years for municipal undertakings within their province. There are isolated cases of even longer periods—such as Glasgow—where an old Act gives that city 62 years in which to repay its debt, while we in provincial England are allowed by the Local Government Board a period of only 25 years. If application be made to Parliament by way of Bill for extensions of electrical works, the undertakers are granted 25 years only, it is true, but are given a remission of the sinking fund instalments for one, two or three years, a point which was strongly sympathised with by the Committee on Repayment of Loans in 1902. The Local Government Board, however, is unable to do this, and thus those who proceed by the less costly method of provisional order have to pay this sinking fund on all extensions and new loans before it is possible for the new capital to have earned any revenue. Another case: If a Council apply to Parliament for a Bill to construct and work its tramways and to build the necessary power house, a period of 30 years is granted for the repayment of the whole loan (in some cases, of course, longer periods being given for land, and the usual period of five years for the costs of the Act); but if the same Corporation provide the necessary power house through *an extension of its electric lighting undertaking and instal identically the same plant as in the former instance*, the loan must be repaid in 25 years. If plant which runs at least 17 hours a day and is subject to the severe conditions of tramways supply can be given the longer period, why should not electrical undertakings be given at least the same extended period, especially when the plant is subjected to less severe conditions; and if 42 years is the legitimate period for repayment of loans in London, why should provincial undertakings be called upon to repay theirs in 25 years?

Everyone points to the general excellence of management in Glasgow, the second city of the Empire. If 62 years is proved to be a legitimate and not unduly long time there, why cannot the rest of us be given similar privileges? A curious anomaly to me is that electric lighting undertakings are only allowed 25, and tramway undertakings 30 years, when I am of opinion that the reversal of these periods would bear a more real proportion to the lives of the undertakings.

Now, the point which I wish to emphasise is this: the financial regulations of the Local Government Board, to which we are subjected, require a very drastic alteration. Some of our plant (such as accumulators) has a natural life of only 10 or 11 years, some 25 to 30 years, and some 50, 80, or 100 years. A sinking fund which repays a debt in 25 years is a clumsy and unsound instrument for writing off plant which is non-existent in the eleventh year under existing conditions, although the 25 years is supposed to represent the "equated" life of the whole of the installation. The present method of the Board in such a case is to grant a further loan for the replacement of this portion of the plant, for which they grant a period of 10 years. The result is that from the eleventh to the twenty-first year a two-fold sinking fund on this particular plant has to be paid, and then in the twenty-first year the plant again is non-existent, and a third loan has to be applied for. This,

of course, is nonsensical. That is one extreme view of the question. On the other hand, buildings, stoneware casings, cast-iron pipes, roadwork for mains, and land will have depreciated but very slightly in 25 years, and if Parliament has safely been able to grant 60 years to gas and water undertakings for their pipe lines, reservoirs, &c.—subjected as they are to much more serious depreciating action than those I have enumerated—I say that we have every right to take this extended period as the natural life of *those portions* of our undertakings. I do not want to argue from false premises, as a critic might say that one has no right to assume that the 60 years for gas and water undertakings *is* a legitimate period; but basing one's estimate of the life of these items from other engineering sources within one's experience, I cannot come (nor, I am sure, can anyone else) to any other conclusion. Under the Public Health Act, 60 years is the maximum period allowable. In 1901 a table was laid before the Association by Mr. Newington, of Edinburgh, in which the life of all the details of a representative electrical undertaking was set forth, and this received the unanimous support of the Council. That table made out that, at any rate, the equated life was well over 30 years. I have most carefully applied the like reasoning to several undertakings in very great detail (including that of which I am chief officer), and I cannot make the figure less than 42·8 years. I presume that the shareholders of electrical companies will expect to get this life from their own undertakings—in fact there are companies which have been in existence for very nearly half this period already and show very little signs of collapse: on the contrary, they become more remunerative each succeeding year.

Clause 52 of the model provisional order sets forth that undertakers may set aside annually from their profits a reserve fund up to a limit of 10 per cent. of the aggregate capital expenditure, and also that when the surplus in any year exceeds 5 per cent. it shall be compulsory upon the undertakers to make a reduction to their customers. I suggest that a better system of finance would result from the following amended regulations:—

All municipal electrical undertakings should be granted a period of 42 years for the repayment of loans. Each application for a loan should be subjected to an inquiry of the Board of Trade so as to ensure that respectable schemes only were submitted, and it should be compulsory upon the municipal authority to set aside an additional sum (over and above the sinking fund thereby entailed) of 1½ per cent. of the value of the capital expenditure commencing not later than two years after such expenditure had been made, to form a depreciation fund. If the gross profits of the undertaking were unable to meet this liability, then the deficiency to be met from the local rate, as at present; or, if the deficiency continue for more than a given period, the charges for energy supplied to be raised so as to meet the deficiency. Now, the capital charges on an undertaking taken at 42 years and with 3½ per cent. interest will amount to £4 17s. 6d. per cent.; and upon the same basis for 25 years, amount to £6 8s. 7d. per cent., showing a saving of £1 11s. 1d. per cent. per annum, against which has to be set the 1½ per cent. for the depreciation fund. As an example, take the expenditure on the electrical undertaking of this town. Our capital expenditure to date is £224,000, and our average capital expenditure for the last twelve months was £211,600. The accumulated sinking fund paid out of gross profit is £20,073, which amounts to practically 10 per cent. of the average capital outlay. We have no depreciation fund in addition to this amount, although we have a small reserve fund, and intend, of course, to add to this fund when we can. If the conditions which I suggest had existed from the first we should have had about £10,500 in the sinking fund, and £9,600 in the depreciation fund, representing 4½ per cent. on the average capital outlay. I assert that this would have been a sounder financial position than the present. A sinking fund is an absolutely inflexible sum which cannot be appropriated for any other purpose, of course, than the cancellation of the original debt, but electrical undertakings require something over and above this—a fund from which sums can be taken from time to time to make good any shorter-lived and worn-out plant.

It has always been argued that the 21 years' life which was given to company undertakings by the Act of 1882 (after which period municipalities could buy an undertaking at its then value) was an insufficient period for the use of the shareholders' money, and that the proper thing was done when Parliament (Sec. 2, Electric Lighting Act, 1888) increased this period to 42 years. What then do we find these companies doing, controlled as they are by most able financial and engineering experts? They are content to form a depreciation and reserve fund which amounts to something like, and, so far as I am aware, often much less than, 10 per cent. of the capital outlay. Presumably, therefore, this must be considered a sound position, otherwise companies could never have the stability which they enjoy. As this is true of company undertakings, what logic or reason is there in refusing to give municipalities precisely the same privileges; or why should municipalities pay more than companies? Both will have enjoyed 42 years' use of the original capital, and will be, as a result of their trading, able to re-enter on their obligations to their consumers.

I want to see municipalities placed on a par with admittedly well regulated companies, and I believe that the extended period of repayment, the compulsory formation of a depreciation fund in addition to this extended sinking fund, and an inquiry upon each loan by a properly constituted section of the Board of Trade composed of a few electrical experts, would prove a panacea for the present evils. It would have the effect, further, of bringing all the present anomalies into alignment, and it would enable municipally-controlled undertakings to be governed on thoroughly sound financial lines.

The present Government has just authorised the formation of a Royal Commission to inquire into the whole question of municipal trading. I do earnestly hope for the good of municipal electricity, and for the whole electrical industry at large, that vigorous action will be taken by the Association of Municipal Corporations, and by ourselves, backed up, I hope, by the loyal co-operation of the Institution of Electrical Engineers and the electrical press, to attain this end. This may be Utopian, but I have faith in the common sense and justice of these bodies, and I believe that this item—which I consider to be the most important on our costs sheet to-day—can be thus more fairly apportioned among the present and succeeding generations.

Another point on which I wish to speak is the tendency of many municipalities to allow tried and capable officials to leave their service at a critical time in the development of their systems. I think it wise that a municipality should engage an independent expert engineer to launch the undertaking and to assist in the selection of a capable chief officer. This officer being appointed, will then seriously consider local conditions, and if he is worth anything at all will devote his energy to the proper and careful development of the work entrusted to him. But being young and ambitious he will be naturally allured to another town offering a wider field and a bigger salary, and I have known men who have been allowed to leave because their councils have been niggardly, and have declined to increase salaries which were entirely disproportionate to their serious responsibilities. One does not hear of the like changes on the staffs of the larger companies. A change of management in such a case must affect, temporarily, the progress and development of the system, for it takes time for a new man—however capable—to acquire a thorough knowledge of local conditions, and even a slight change of policy may cost the municipality a great deal of money. Councils, I think, want to form an idea of the depreciation of the engineers, the wear and tear on whom is a really serious factor, for the responsibility of electrical supply undertakings is a very heavy strain. I think more encouragement is required to be given to officials of proved efficiency.

There is a tendency to attempt to make engineers, who are responsible for the selection of contracts, stray from their strict sense of duty by offering, directly or indirectly, some inducement to them to become biassed in favour of some particular plant. We have maintained an excellent record for purity of conduct, and the result is that, young men as we all are, we have earned the respect and confidence of our Councils, which it must be our endeavour to retain.

There are many questions which must give rise to anxious thought: the progress of gas engines and the production of high calorific gas; the improvement of the steam turbine; the probable economies in methods of electrical illumination; the increasingly greater scope of electrical applications; all present material for judgment in forecasting their influence upon future extensions. One wishes that more progress could be made with electrical storage, as an efficient battery would very materially alter the problem of electrical supply.

I sincerely hope that the Sunderland and District Convention will be a means of widening our knowledge, and, together with the hospitality and assistance which I know is to be given to the Association by the Corporations whose towns we shall visit, will be productive of much real good.

PROVISIONAL ORDERS, 1903.

THE report of the Board of Trade respecting applications for lighting orders in the present session has been issued and contains several points of interest. Powers having been already granted for most of the large towns, the promotions are now restricted to the smaller communities, and are less numerous than in former years.

The total number of provisional orders applied for is 53, several of which are for extension of areas where supply works already exist. The orders granted were promoted by 32 local authorities and 20 companies. Among the applications of interest, as marking the policy of the Board of Trade, may be mentioned the following:—

The Urban District Council of Bedwellty, a South Wales district, applied for powers, evidently against the wishes of the ratepayers. Representations having been made to the Board of Trade, they held a local inquiry, and after considering all the circumstances of the case, refused to grant the order.

As we have frequently pointed out, all these useless expenses and proceedings would be avoided if the consent of the ratepayers were obtained as a condition precedent before memorialising the Board of Trade to grant an order.

A similar case occurred with the town of Caerphilly—another district of South Wales—where municipal trading in electricity supply appears to be also objected to, and this application was dealt with in the same way, and the order refused.

Another case from the same county (Glamorgan), met with a similar fate, the Rural District Council of Llantrisant and Llantwit Fardre, having applied to the Board of Trade, who refused to grant the order after a local inquiry.

In several cases the consent of the local authorities has been dispensed with, and special reports made by the Board of Trade to Parliament; this occurred with companies' applications for Kilmalcolm, Sandwich, Walmer, Stone, Swanscombe, and Wilmslow.

On the other hand, the applications were refused in the cases of Chipping Norton, Dorking and Londonderry.

Within the County of London there were only two applications in the present session, and in both cases the action of the Board of Trade appears to have been influenced by the question of com-

petition in supply. In one case—that of Bermondsey—the Borough Council applied for an order which was refused by the Board of Trade, there being two companies already authorised to supply electricity in the area applied for. The other metropolitan case is that of Camberwell, where the Borough Council consented to the grant of an order to the London Electric Supply Corporation, Ltd.; but the Board of Trade, having regard to all the circumstances, refused the order, adding the significant remark that, if they had granted it, Parliament would not have assented to it.

In several cases, as we have mentioned, the orders are for extending the areas of supply under former orders. The cases in question include additions to the districts of the Cambridge Electric Supply Co., Ltd., the Isle of Wight Electric Light and Power Co., Ltd., the Leatherhead and District Electricity Co., Ltd., the Corporation of Stafford, the Tadcaster Electricity Co., Ltd., the Uxbridge and District Electric Supply Co., Ltd., and the Wimbledon Urban District Council. The order for Sevenoaks replaces one granted in 1900 and revoked. It will thus be seen that the actual number of new undertakings is even less than the figures of the return indicate.

Since the date of the last report deeds of transfer have been approved by the Board of Trade in respect of Hindhead, Leatherhead and Slough, all transferred by the local authorities to companies, and the Warwick order, which was granted to one company is now transferred to another.

The New Electric Lighting Bill recently introduced into the House of Lords by the Board of Trade will not be proceeded with in the present session, but the indications it gives of the future policy of the Department will be of great value.

INTERNATIONAL FIRE PREVENTION CONGRESS.

On Wednesday, July 8th inst., two papers were read before the Section dealing with electrical safeguards and fire alarms, by Mr. Alex. Siemens on "Safety and Control Arrangements for Fire Alarms," and by Mr. G. H. Oatway on "The Necessity for Automatic Fire Alarms with Direct Brigade Communication."

Mr. Siemens's paper recalled the system of telegraphic alarms devised by Dr. Werner von Siemens more than 50 years ago, which has been widely adopted in various forms for street alarm services. Briefly described, the various alarm stations are grouped in circuits, each of which includes a Morse recording instrument at the fire station. Telephones and Morse keys can be added at the alarm stations if desired. For control purposes a constant current is employed, as also are metallic circuits without earth connections. On an alarm being given a wheel actuated by clockwork is set in motion.

The variously shaped projections on the wheel, which vary in each alarm pillar, break and make the circuit and produce distinctive signals in the fire station, in which also a bell is rung, when the current ceases to be constant. As a precaution against faults in the circuit, a milli-ampere meter is inserted, which should give a steady indication. In a fire station from which several circuits go out, another measuring and detecting instrument is provided for the purpose of locating any leakage of sufficient magnitude. If such existed, the attendant would be warned by a bell attached to the apparatus. When a fault has been detected, it can be located by any ordinary method. With a view to preventing simultaneous signals from two alarm stations, the clockworks in the alarms are controlled by electro-magnets which prevent or delay its working when no current or intermittent currents are passing in circuit, so that when one signal is completed, a second one from another point is automatically sent on and recorded at the fire station. Mr. Siemens further discussed the protection of such circuits from lightning or from accidental contacts with high-tension lines, by means of vacuum lightning dischargers and fuses.

In the short discussion which followed, it was mentioned that if one fault occurred before another was repaired, it would result in some of the boxes being temporarily cut off; at the same time the system has been in successful operation for 19 years in Dunedin, New Zealand, with a slight addition of visual indicators on the alarm boxes, to show that they are in working order. The system is being adopted in several German towns since the recent fire exhibition at Berlin called attention to its merits.

Mr. G. H. Oatway's paper dealt more particularly with the arguments in favour of some automatic indication direct to the brigade station from the block of buildings or from the particular room affected in case of fire. He pointed out the shortcomings of street alarm systems, in that the brigade were ignorant of the exact location or extent of the fire, and he strongly emphasised, what will be apparent to all, the necessity for an early call.

The paper gave some interesting figures, from which it appears that the Glasgow Fire Brigade had during 1902 716 fires, involving a loss of £189 000; of this amount 40 per cent. is accounted for by three fires and 73 per cent. by 10 fires. Glasgow possesses one of the best street alarm systems in the kingdom.

After tracing at some length the history of the evolution of the fire alarm since A.D. 1625, Mr. Oatway comes to the present day systems, and enumerates the functions of a perfect alarm. The functions which would meet with the approval of quite 99 out of every 100 brigade experts in an automatic fire alarm system were:—

(*a*) To detect the fire at a uniformly early period under all atmospheric or industrial conditions;

(*b*) To give the alarm upon the premises, and simultaneously to the brigade by a definite and unmistakable message; and

(*c*) To facilitate the work of extinction by indicating the exact position of the outbreak in the building attacked.

The first of these functions—the root or foundation of the whole—is the one which proved so generally fatal to the legion of devices which the nineteenth century produced. His own experiments with thermometers and fuses were disappointing, and in order to get over the disability referred to, he fell back upon the principle of compensation, and the compensator which forms one of the two principal parts of the detector employed in the May-Oatway system, by its own expansion or contraction, automatically maintains the uniformity of the rise necessary to produce the alarm under any and every working condition. The detector consists of a steel rod of rather unusual form and cross-section, to which a copper wire 7 ft. in length is attached; and at the centre of the combination a contact tube holding the carbon bridging piece is placed. The latter is suspended by a silver chain to the detecting wire, and is held at a distance above two platinum terminals attached to the steel rod. The distance between the two is determined by the margin of rise set for the alarm. This, in practice, is usually 25° F. The object of yoking the detecting wire to the compensator is that the expansion of the one may equal the expansion of the other so long as the heat rise is the comparatively gradual one due to gas light, the radiators, or other normal causes. The degree of elongation differs slightly in extent, it is not a mathematical fixture, but the approximation is so close that the pair is a good one for all working purposes, and the absolute immunity from false alarms and the ability to respond to a satisfactory heat test at any time, establish the value of this combination beyond all doubt.

One feature of the automatic fire alarm system upon which all authorities agree is the necessity for systematic and detailed testing, and this detector can be tested by heat, or mechanically by lifting a test weight which lowers the bridging piece, and establishes or breaks contact just as is required by the open or closed circuit employed in the case under review. As soon as the heat is withdrawn, or the testing weight released, the contacts return to their normal position.

In regard to the second function, it is hardly necessary to say that the closed or open circuit immediately operates the relays which energise alarm gongs. These may be fixed in any desired position. There are over 600 of these "nerve centres" in a large warehouse with which he had had to deal, all yoked up to four position indicators, three of which repeat upon the master indicator; and this in turn controls and actuates the local alarms and telegraphs the central fire station. The method of calling is unique but simple. An automatic transmitter is used, and the code cipher it is intended to send is cut upon the periphery of this disc. So long as the unindented edge of the disc is between the printing key and the printing point, there is no message; but so soon as the armature is pulled down by the current switched on by the automatic detector described, then away goes the disc, a legibly engraved shutter is dropped in the central fire station, and the code cipher is repeated four times, calling up the brigade.

The third function is the device which guides the fireman to his work. The details employed are very simple. There are as many rows of shutters as there are flats in the building, and as many shutters as there are rooms. As each room is affected its indicator is actuated, and thus the whole area of the fire, with the direction it is taking, if spreading, can be seen at a glance.

In concluding the paper it is interesting to note that the great tariff companies now allow New Zealand property owners a substantial rebate, as the result of five years' successful practice in the colony.

A majority of the meeting found themselves fully in agreement with Mr. Oatway in the use of auto-alarms, and their extensive use in the States was pointed out.

Mr. Segundo pointed out that the Fire Brigade cost about double per head of population in London compared to other large provincial towns, but the fire loss was also double. He advocated the use of injector hydrants in connection with the high pressure mains of the Hydraulic Power Co., laid throughout London.

On Thursday, the 9th inst., papers were read by Mr. E. C. de Segundo, on "Electric Wiring and Fire Risks," and by Mr. Alfred Hands, on "Necessary Practical Safeguards against Fires caused by Lightning." The object of the former paper was to call attention to the importance of sound work in the wiring of buildings for electric light and power.

Experience has shown that a building lighted by electricity enjoys complete immunity from risk of fire, provided always that the erection of the wires and fittings has been carried out in a sound, workmanlike manner, but that the keen competition amongst electric wiring firms, owing to the short-sighted policy of the owners of buildings who are apt to think more of first cost than of possible subsequent outlays, has acted as a powerful stimulant to "jerry" wiring.

It was foreseen at an early date that one of the chief obstacles in the way of the popularisation of the electric light would be the cost of installation of the necessary wires and fittings, and a reduction in this item is quite as necessary as a reduction in price, and for this reason large numbers of consumers under-estimate the value of insurance companies' and other rules. From personal experience he pleaded for a higher standard than that which would satisfy the fire insurance companies' surveyors.

The paper then briefly points out the more important points to be watched:—

1. The means adopted for insulating the wires
2. The means adopted to prevent mechanical injury to the insulation of the wires.
3. The sub-division of the main circuit and the proportionment of the size of the conductor to the work it has to do.

4. The means adopted to guard against accidental overloading of the conductor.

5. The nature of the joints made in the conductors (if possible, no joints should be permitted between the terminals of the various pieces of apparatus involved).

6. The design of the fittings with special reference to ease in wiring without injury to the conductor.

7. The method of manufacture and erection of fittings and accessory apparatus (switches, fuses, &c.).

8 The general scheme of wiring and method of fixing in place wires, casing, or tubing, &c., and main and accessory fittings, so as to avoid the danger arising from proximity to gas and water pipes and ironwork of all kinds.

The author then briefly referred to the conducting and sectional area of conductors, and the principle of "fusing" circuits, the protection afforded by their use being of a relative character. For safety against risk of fire one must depend entirely upon the means adopted for keeping the electric current within its designed sphere of action, and this includes (1) the insulation on the wire; (2) the means adopted to guard against mechanical injury and damp.

For such wires as we are dealing with, the material hitherto used as insulation has been mostly rubber. Some so-called rubber insulation taken from electric cables has been found to contain less than 20 per cent. of rubber. Up to the present nothing has been found to touch best quality rubber specially prepared to resist the oxidising action of the atmosphere, and the deleterious influence of any rise in temperature of the conductor. Damp is most insidious in its action, and every effort should be exerted and every means adopted to safeguard the installation from its evil effects.

Unfortunately, gutta-percha, on account of its extreme sensitiveness to the oxidising action of the atmosphere and to the action of moisture and light; and because of its softness and plasticity at a temperature only slightly elevated above normal is useless for wiring houses. It is possible, however, that before long a new form of insulator may be introduced upon the English market, which, while possessing all the useful properties of gutta-percha, is practically indifferent to the action of light and air, and is very much harder than gutta-percha. Large quantities of wires insulated with this material have already been used on the Continent with excellent results.

The author then dealt briefly with the mechanical protection of wires. The ideal method, he said, was to use nothing but the highest class vulcanised or other suitable rubber insulation, with some suitable form of mechanical protection in the way of braiding merely to protect the wire from injury during its passage from the factory to the place at which it was to be erected, and to enclose the wires in a continuous system of cold drawn steel tubes specially selected for smoothness of bore, with joint boxes inserted at all points necessary to enable the drawing-in of the wires to be carried out without injury to their protective covering and to facilitate inspection, withdrawal of any wires for the purpose, if need be, of increasing their size, &c., the whole system of steel tube and joint boxes being connected to earth. Such an installation constituted the best means of securing immunity from fire due to electrical causes.

In the short discussion which followed, Mr. Broadbent disagreed with the suggestion to use iron conduits, which he thought led to greater possibility of fire than ordinary wood casing. He instanced numerous cases of fire caused through accidental contact and short circuits in fittings, &c.

Other speakers considered that steel conduit systems were the best, and it was suggested that more complete inspections of installations were necessary.

OUR LEGAL QUERY COLUMN.

[Questions addressed to the Editors for insertion in this column should be written on one side of the paper. Free use of fictitious names, &c., may be made. Answers are furnished by a duly qualified lawyer, but the Editors cannot undertake to be responsible for the accuracy of the views which he may express.]

"BUCKLEIGH" writes:—"We should be much obliged if you would give us some information *re* an electric supply.

"In a certain town we have been asked by the Town Council to supply the current for street lighting. This will be decided by the Council, and thus they will give us the contract. Can we start work at once or have we, or have they, to get the sanction from the Board of Trade? Can we begin the work on the supply, as well as the private supply, without permission from the Board of Trade? We should use bare copper overhead two wires, 100 volts."

*** We cannot see any reason why our correspondents should not furnish the supply in question. There is nothing in any of the Electric Lighting Acts to prevent a private company from supplying electricity without the sanction of Parliament; the difficulty which usually stands in their way being opposition on the part of the local authority. In the present instance, however, it would seem that the local authority are consenting parties, and will give all necessary wayleaves.

With regard to the Board of Trade regulations, it is to be observed that where electricity is supplied otherwise than under the terms of a provisional order, there are certain rules which have to be obeyed. To state what rules pertain to the works, which our correspondents are about to undertake, would occupy too much space; but we should recommend them to procure a copy of the rules which may be obtained from Messrs. Eyre & Spottiswoode, London, E.C., for a few pence. The rules state the requirements of the Board of Trade in the clearest possible manner. So long as these rules are observed, the Board of Trade are not likely to raise any objection either to the supply for street lamps or for private consumers As a measure of precaution we should recommend that the plans be laid before the Board before the work is commenced.

"ASSISTANT ENGINEER" writes:—"A certain Corporation has, for some years, supplied a consumer at 100 volts pressure, the consumer also having a private supply at 100 volts, with change-over switch-gear for use on the town's mains after the main engines are shut down. Can the Corporation compel this consumer to change-over to 200 volts pressure. This will necessitate the consumer having his machine re-wound for 200 volts or trusting entirely to his private supply. I may mention that the only reason the consumer is connected to the Corporation mains is that at night with, say, 20 or 30 lights burning, it would be rather expensive to have his 40-KW. set running specially for these few lights. Now the point I wish to get at is this, Can the Corporation compel this consumer to change over? If they can do so, who pays the necessary expense?"

*** The question of "changing-over" is one which has given rise to considerable difficulty. In the first place it should be observed that under the existing law relating to electric lighting it is quite competent for any consumer to have his own plant, and to avail himself of the public supply when he chooses. The Corporation from which "Assistant Engineer" takes his supply have, therefore, no right to object to the course which he has adopted. The regulations with regard to standard pressure have undergone certain important modifications during recent years. Formerly, the standard pressure having been fixed by the undertakers, no change could be made in the pressure of the supply to any premises which at the date of the regulations were supplied with energy by the undertakers except with the consent of the consumer.

The standard pressure cannot now be altered except by permission of the local authority, and upon the terms and conditions imposed by the local authority; but by a regulation made in 1901, if the consumer withholds his consent to any change which the undertakers propose to make in accordance with the regulations of the local authority, or to pay the reasonable cost of, and incidental to, the change, the undertakers may appeal to the Board of Trade, and that Board may, if they think fit, give their consent to the change on such terms and conditions as they impose, and the consent of the Board so given shall, for the purpose of this regulation, have the same effect as the consent of the consumer. It will thus be seen that if a consumer persistently refuses to "change over," he may be compelled to do so in certain circumstances. It is possible that if the matter were to go to arbitration, as generally happens where there is a dispute, the fact that the consumer would have to change his own private generator would be taken into consideration. We do not know whether the question has ever been decided.

REGENERATIVE TRAMCAR CONTROL.

UNDER the auspices of the British Electric Traction Co., a demonstration of the regenerative system of tramcar control was given on July 9th on the Devonport and District Tramways. This is a very hilly and difficult system, and one that includes many steep gradients and difficult corners, with only a very small proportion approximating to a level track. It is, therefore, one upon which any advantages possessed by such a system should be brought prominently into view.

The car used for the demonstration was an ordinary single-truck double-deck car, which was taken from regular service some five or six months ago, and fitted with the experimental apparatus, the existing motors being used, with modified field windings, and an entirely new type of controller.

Though a diagram of connections cannot be given, the system may be generally described as consisting of two 25-H.P. motors, shunt-excited for general running purposes, and provided with series windings for emergency use. The motors are coupled in series, the armatures and a regulating rheostat forming one circuit, and the shunt windings, together with a regulating rheostat, forming the other. To start the car, the first operation is to close the shunt circuit through the whole resistance, cutting the latter out in steps until the fields are fully excited; with the shunt regulator in this position, the armature circuit may be closed and speed regulation obtained on the main rheostat up to about two miles per hour. Speeds greater than this are obtained by reducing the shunt excitation.

The controllers, as arranged, do not provide for any reversal of the car; should it be necessary to run backwards, the driver must change ends.

When descending gradients, the motors act as shunt excited generators, returning power to the line, the speed of the car being under the control of the driver to the same extent as when ascending.

This return current, as shown upon recorder sheets taken during previous trial trips, rises to as much as from 40 to 45 amperes, with kicks up to 60 amperes, produced when rapid stops are made.

It is also claimed for the system that, in climbing hills, the current taken from the trolley line is less at the same speed than with series-parallel control.

Should the trolley leave the overhead wire, or the power supply to the trolley line fail, the motors would at once lose their excitation, and therefore fail to retard the car on a downward gradient; to meet this contingency, an automatic switch is provided, controlled by the current passing through the shunt circuit, which, on the shunt current failing, introduces the series windings together with resistances through which the motors are short-circuited. They then act as an ordinary emergency brake, with motors coupled in series. The controller is also provided with an emergency stop handle, to enable the series windings to be brought into use assisting the shunt windings.

After proceeding over the various routes, a stop was made at the car depôt to inspect a second car, arranged on the same system, but with controllers so modified that a parallel arrangement of armatures can be obtained, with a consequent increase in the maximum speed obtainable. This car was not seen in operation, owing to some slight mishap in the nature of a short circuit that had occurred in the early morning amongst the temporary connections. It was, however, stated that very satisfactory results had been obtained.

After luncheon, to which the guests were invited by Mr. J. S. Raworth (chairman of the B.E.T. Co.), he stated, amongst other explanatory remarks, that the results of trials made with two cars—one equipped with series-parallel control, and the other with the regenerative control—showed an average consumption over the whole of the routes of 1·3 units per car-mile for the series-parallel car, and 1·0 unit for the car with regenerative control, a saving that, if realised in ordinary working, will be of great importance.

He also drew attention to the fact that the rate of acceleration, though not so great as with the series-parallel control, was sufficient to enable the special car to keep to schedule times, and he made a comparison between the practice of a driver who on an ordinary car raced to the terminus in order to enjoy a quiet smoke, making-up for lost time by means of a "donkey gallop," and that which he would be forced to adopt on a regenerative control car, with a fixed rate of acceleration and a maximum speed that could not be exceeded whatever the gradient.

The experimental cars have proved so successful that the company intends to fully equip the Devonport system with cars fitted with the new type of control. When the conversion is complete, it is expected that a saving in cost of energy of £1,500 to £2,000 per annum will be made.

THE ENGINEERING STANDARDS COMMITTEE.

The work in which the electrical side of the Engineering Standards Committee is engaged, cannot fail to be of interest to the readers of the Electrical Review. To give more than a brief outline of the work at present in hand, would, obviously, be impossible. The scope of the work of the electrical section is enormous, entailing a great deal of serious labour, the result of which it is anticipated will have far-reaching effects, and will materially simplify and cheapen the manufacture of electrical machinery throughout this country.

Besides the Electrical Plant Committee, there are at the present time, we are informed, several sub-committees sitting, the constitutions of which are given on the following page.

A glance at these lists will show the extent to which the Government is supporting the work of the Engineering Standards Committee. It has officially appointed members to represent the different Government departments on the Main Electrical Plant Committee, and also on several of the Sub-Committees; furthermore, the Treasury of his Majesty's Government has expressed its warm approval of the work, and has included in the Board of Trade Vote for 1903—4, the sum of £3,000 towards the funds of the Engineering Standards Committee. We believe we are correct in saying this is the first time that the Government has accorded financial support to a practical movement of this nature, and we feel sure that the money of the tax-payers could not be applied to a worthier object, or to one which would tend more to promote the best interests of the trade of this country.

The Main Electrical Plant Committee met in July, 1902, and decided to take evidence as to the advisability of standardising electrical plant. The evidence was divided up under the following heads:—

(A) Physical standards.
(B) Mechanical standards.
(C) Telegraphs and Telephones.
(D) Power.
1. Generation and transformation.
2. Transmission and distribution.
3. Utilisation.
(*a*) Light.
(*b*) Traction.
(*c*) Power.
(*d*) Heat and electro-chemics.

Several sittings were taken up in hearing this evidence, and the Committee then decided to form a number of sub-committees to deal with the different branches of the work. The first to be formed was the Sub-Committee on Generators, Motors and Transformers, with Col. R. E. Crompton, C.B., as chairman. This Sub-Committee, we understand, has held a number of meetings, in consequence of which several circular letters have been issued dealing with questions in the matter of standardising prime movers for electrical purposes, also proposals for standard voltages for continuous currents, &c. A Conference of Steam and Gas Engine Builders was held at the Institution of Mechanical Engineers, which has been of material assistance to the Sub-Committee in the difficult task of making recommendations.

In connection with this work a small Committee has been formed under the title of the "Sub-Committee on the Temperatures of Insulating Materials," consisting of Dr. Glazebrook (chairman), Col. H. C. L. Holden, R.A., Commander G. L. Sclater, R.N., Captain A. H. Dumaresq, R.E., and Captain H. R. Sankey. Under Dr. Glazebrook's direction experiments are at present being carried out at the National Physical Laboratory to determine the limits of temperature that the insulating materials used in the construction of electrical machinery will stand, and also the permissible rise in temperature in those materials. Experiments are also being carried out in order to ascertain the relation between temperature taken thermometrically and temperature taken by increase in resistance. Several large manufacturers have been asked to assist the work of the Sub-Committee by undertaking similar experiments at their own works. No definite recommendations as to permissible temperature rise in electrical machinery can of course be made until these experiments are completed. We are informed that at the present time the Sub-Committee on Generators, Motors and Transformers has under its consideration the issue of further circular letters.

The Sub-Committee on Telegraphs and Telephones, of which Mr. John Gavey, C.B., chief engineer of the General Post Office, is chairman, has not as yet held many meetings, but it is discussing at great length the question as to what units should be recommended in specifications for copper, bronze and iron wire. The standards for copper and other matters are being discussed by this Sub-Committee, but no definite conclusions, we believe, have as yet been come to.

The Sub-Committee on Cables, of which Mr. Robert Kaye Gray, the President of the Institution of Electrical Engineers, is chairman, is discussing such matters as copper standards, the issue of tables of conductors, &c., and is at present engaged in gathering information relating to conduits. This Sub-Committee has not made sufficient progress in its work to be able to make any definite recommendations.

Two other Sub-Committees are being organised, one to

deal with electrical tramways and electrical railways, the the chairman of which is Mr. A. P. Trotter, electrical adviser to the Board of Trade, the other to deal with central station rules, including in its reference the standardisation of electrical fittings generally. The chairman of this Sub-Committee is Mr. C. H. Wordingham, electrical adviser to the Admiralty.

This brief outline does not pretend to cover all the ground, but it will, we hope, serve to show the very responsible work in which the Engineering Standards Committee is engaged.

ELECTRICAL PLANT COMMITTEE

Sir William Preece, K.C.B. (chairman).
Lieut.-Col. H. C. L. Holden, R.A. } Representing the War Office.
Captain A. H. Dumaresq, R E. }
Commander G. L. Sclater, R N. } Representing the Admiralty.
L. J. Steele, Esq. }
John Gavey, Esq., C.B, engineer-in-chief to the Post Office.
A P. Trotter, Esq., representing the Board of Trade.
Dr. R. T. Glazebrook, representing the National Physical Laboratory.
Col. R. E. Crompton, C.B; Philip Dawson, Esq.; S. Z. de Ferranti, Esq.; Robert Kaye Gray, Esq.; Mark Robinson, Esq.; R. Percy Sellon, Esq; Alex. Siemens, Esq.; James Swinburne, Esq.; C. H. Wordingham, Esq.

SUB-COMMITTEE ON GENERATORS, MOTORS AND TRANSFORMERS.

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Lieut.-Col. H. C. L. Holden, R.A. } Representing the War Office.
Capt. A. H. Dumaresq, R E. }
Commander G. L. Sclater, R.N. } Representing the Admiralty.
L. J. Steele, Esq. }
Llewellyn Preece, Esq., representing the Crown Agents for the Colonies.
Dr. R. T. Glazebrook, representing the National Physical Laboratory.
B. H. Antill, Esq. } Nominated by the Electrical Engineering
W. B. Esson, Esq. } Plant Manufacturers' Association.
A. C. Eborall, Esq.; S. Z de Ferranti, Esq.; Robert Hammond, Esq.; Captain H. R. Sankey.

SUB-COMMITTEE ON CABLES.

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Capt. A. H. Dumaresq, R.E., representing the War Office.
L. J. Steele, Esq., representing the Admiralty.
Llewellyn Preece, Esq, representing the Crown Agents for the Colonies.
Martin F. Roberts, Esq., representing the G.P.O.
H. A. C. Saunders, Esq, representing the Eastern Telegraph Co.
T. O. Callender, Esq.; W. E. Gray, Esq.; A. H. Howard, Esq.; Alex. Siemens, Esq; H. A. Taylor, Esq.; A. P. Trotter, Esq; C. H. Wordingham, Esq.

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H. Hartnell, Esq., representing the G.P.O.
Frank Gill, Esq., representing the N.T. Co.
J. Sayers, Esq. } Nominated by the Railway Telegraph
T. Ireland, Esq. } Superintendents and Electrical Engi-
H. Jackson, Esq. } neers' Conference.
A. H. Howard, Esq.; F. Jacob, Esq.

SUB-COMMITTEE ON ELECTRIC TRAMWAYS.

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J. H. Rider, Esq. (London County Council).
H. M. Sayers, Esq (British Electric Traction Co.).
J. J. Steinitz, Esq. (Brush Electrical Engineering Co.).
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Philip Dawson, Esq.; A. M. Sillar, Esq.; R. H. Scotter, Esq.

SUB-COMMITTEE ON CENTRAL STATION RULES.

C. H. Wordingham, Esq. (chairman).

CHLORINE SMELTING WITH ELECTROLYSIS.

A PAPER bearing the above title was read before the Faraday Society recently by Mr. J. Swinburne, vice-president, which describes the new method of working sulphide ores elaborated by Mr. Ashcroft and himself. Essentially the process consists in attacking any simple or mixed metallic sulphide in a state of fusion with chlorine, whereby under suitable conditions sulphur is given off in the elemental condition, and is capable of condensation, while a simple or mixed chloride of the original metal or metals is left. This chloride residue is then treated by chemical means, all its metallic constituents being eventually displaced by zinc: until the final zinc chloride is ready to be dissociated by igneous electrolysis, giving the chlorine required to open up a fresh quantity of ore. The method, accordingly, recovers all the ingredients of the mineral as elements, except the iron and manganese, which are obtained as their highest oxides; the former being amenable to a process of furnacing to develop its colour and render it saleable as the pigment of an oxide paint, or being capable of reduction to yield really pure iron, if a market should be open for it. The only reagent needed is zinc chloride, zinc itself, or hydrochloric acid, as the case may be; and this only in quantity sufficient to make good a small chemical and mechanical loss.

As applied to a complicated material such as lead zinc bluestone, or Broken Hill slime, the process runs as follows:—The ore is crushed and introduced into a 10-ton transformer, which is an iron vessel lined with fireclay somewhat resembling a blast furnace. At the base chlorine is led in through a carbon tuyere, the main gas pipes being of iron, because cold dry chlorine does not attack that metal. In the furnace an exothermic decomposition occurs, so that no artificial heating is necessary; control of the temperature is obtained by feeding in the ore at the proper speed, and by building the furnace in such a fashion that loss of heat by radiation, &c., balances the production of heat. Although there is a considerable margin allowable, the temperature in the transformer must be maintained within certain limits; because if the heat is insufficient, sulphur chloride may be formed (which means wastage of chlorine and of sulphur), while if the heat is too great some of the metallic chlorides may distil over with the sulphur. By means of a chimney, the vaporised sulphur is drawn through a condensing chamber, where it is deposited as a solid, while the chlorine is pumped in at a pressure of 10 or 15 lbs. per square inch. An excess of ore is always kept in the converter to the end of the operation; and when, after stopping the supply, brown fumes of ferric chloride appear, these are by-passed round the sulphur chamber. The ore melts, and the gangue separates, usually floating; finally the charge is run out and allowed to cool. As already mentioned, the further treatment of the melt depends upon its complexity; but in the present case where it consists of the chlorides of lead, zinc, iron, manganese, copper and silver, together with gangue, it is run into water and filter-pressed, the solution being as concentrated as the cloths will bear. In the press remain the gangue and the lead and silver chlorides; the former is separated, and the latter fused with lead to extract the silver and any gold, then with zinc which throws out the lead, leaving anhydrous zinc chloride ready for electrolysis. The filtrate is treated with spongy copper to precipitate any lead and silver in solution; with zinc to throw out the copper; with chlorine to convert the iron into the ferric state, whence it is precipitated as hydroxide with zinc oxide; and finally with more chlorine and more zinc oxide to throw down manganese peroxide. Thus an aqueous solution of pure zinc chloride is left, which is cautiously evaporated to dryness and the residue fused. The evaporation takes place at atmospheric pressure, so that a little basic chloride of zinc is produced; but this is decomposed electrolytically in open vats where cheap anodes are used before the bulk of the pure chloride is dissociated. The fused zinc chloride derived from the lead substitution (cf. *ante*) is then incorporated with the rest of this salt, and the whole is electrolysed with a current of about four volts in closed vessels internally heated, which are kept under a slightly diminished atmospheric pressure to prevent loss of chlorine. The cells are of iron lined with firebrick; but as the latter is porous, they are practically vessels lined with solidified zinc chloride. Any leakage may lead to the introduction of air, but the temperature is too low for the oxygen to attack the carbon anodes. The temperature is kept below the point at which zinc fume is evolved. A pressure of 4 volts suffices for the heating as well as for the electrolysis in a 3,000-ampere vat, and this includes the preliminary treatment of the oxychloride; at 10,000 amperes, 3 volts should suffice. The current efficiency is practically unity. Chlorine cannot be wasted in quantity during the process because of its offensive odour, and the only loss comes through a small proportion of oxychloride in the ferric hydroxide, and through imperfect collection of

the hydrochloric acid formed on evaporating the zinc chloride solution.

The cost of working the process is roughly 30s. per ton of ore over and above the electrical energy. The chlorine probably costs about 1s. per ton for every 1 per cent. wasted, but this is included in the estimate. The total costs thus become the cost of the ore delivered plus 30s. per ton for treatment plus 5 per cent. for unavoidable waste. To this must be added the energy. If steam-electricity cost 0·25 per KW.-hour, the cost per unit of metal in the ore is as follows:—Antimony, 10d.; copper, 4·2d.; lead, (desilverised), 2·6d.; nickel, 9d.; tin, 9d.; zinc, 8·2d.; the silver and gold being neglected. As all the metals are recovered, the value of the products can be calculated from the composition of the mineral, omitting the iron and manganese, and allowing for two-thirds of the sulphur only.

Of other metals which may be present, *antimony* is easily extracted as brown sulphide or as oxide, preferably the latter; it can also be won as a regulus by reduction. *Arsenic* behaves similarly, its chloride being readily obtained. Metallic arsenides are amenable to the process. *Bismuth* would present no difficulty, falling out of solution as oxychloride. *Cobalt* would be recovered as oxide; in presence of *nickel*, the nickel, cobalt, iron, and perhaps manganese must be separated in the wet way. *Copper* comes out as cuprous chloride, which is soluble in the other chlorides; it is deposited as cement copper by zinc, not iron. *Silver* comes out as a rich lead alloy. From copper ores it is precipitated by cement copper from a solution, or it may be thrown down by the Claudet method. *Gold* accompanies the silver. *Tin* works normally.

COMPOUNDED ASYNCHRONOUS MACHINERY.

By G. HOOGHWINKEL, M.I.E.E.

With large power and electric railway schemes under consideration, and the question of the electrification of mining plant in this country now being investigated by a Special Committee, alternating machinery in general, and also high-tension alternators, will, no doubt, be studied and manufactured on a larger scale than has been the case up to the present.

One of the principal drawbacks of this kind of machinery has always been the power-factor, with its troubles of regulation and paralleling, and the impossibility of compounding the alternators so as to allow not only for the non-inductive, but also for the inductive drop in voltage. Another disadvantage is the necessity of a separate excitation. A few years ago, however, the General Electric Co. of America (Mr. Steinmetz) constructed compensated revolving-field alternators which were self-exciting. The arrangement consisted in a continuous-current wound armature and collector, fixed between the field poles and the slip-rings of the alternator, which had the same number of poles as the direct-current armature.

The connections between the two armatures were such that the polarity induced in the exciter armature was somewhat ahead of the exciter field magnetisation. Whenever the main current increased, the current passing through the exciter armature strengthened the exciter field, and thus the generator field. If, on inductive load, the current lagged, the magnetisation produced by the alternating current in the exciter armature came more in phase with the exciter field magnetisation, thus strengthening the field more on an inductive load than with a non-inductive load. The alternating current used in the exciter armature was first transformed down to 75 volts.

This arrangement was complicated, and had several disadvantages, and I do not think many machines of this type have been actually built.

The same shortcomings in the generators apply to the synchronous motors. In this case, however, it is possible by over-excitation of the synchronous motor to reduce $\cos\varphi$ to 1, but this is only possible with a certain load, and has to be regulated when the load varies.

These disadvantages connected with the present three-phase plant have more or less retarded the general introduction of three-phase systems, and it may, therefore, be advantageous to consider a type of three-phase plant which, in the writer's opinion, will be the future type for power and even railway and tramway schemes, in connection with steam turbines as prime movers. This has very ably been pointed out by Mr. Eborall already, but I believe some particulars regarding the advantages and general construction of these machines will be welcomed by many engineers, as none have yet been manufactured in this country.

It is well known that the asynchronous three-phase motor, especially of the squirrel-cage type, is much easier to manufacture, cheaper, and simpler to work, than any other motor on the market. This is, in fact, the ideal type of machinery to be used, both as generator and motor, and the honour of applying this simple principle to the construction of compensated and compounded asynchronous plant belongs largely to Mr. Alexander Heyland, although Mr. Leblanc in 1900 mentioned the possibility of paralleling a number of asynchronous generators with one synchronous generator, the latter in order to supply the wattless current necessary for the excitation of the asynchronous generators. The synchronous machine, however, should be at least 50 per cent. of the total capacity installed, and therefore this arrangement is out of the question. Mr. Leblanc also proposed to do away with this large synchronous machine, and to provide each asynchronous machine with a small rotary to supply the wattless magnetising current. This rotary, however, is much more complicated than an ordinary exciter.

It may be useful, before describing these asynchronous generators, to shortly point out the difference between the synchronous and asynchronous machines. The difference is evident when the machines are loaded. The slip with the asynchronous motor, and the drop in speed which results, are represented by the additional excitation with the synchronous machine.

The excitation of an asynchronous motor remains more or less constant at variable loads (excepting as regards field leakage and slip), but must be strengthened proportionally to the load with a synchronous motor.

The field leakage of an asynchronous motor is far less than with a synchronous motor. A squirrel-cage rotor is a much better bearer for a magnetic field than the revolving poles of a synchronous machine. Also the transmission of the power from stator to rotor is much more efficient (purely electrical) in an asynchronous motor; there is no distortion of the field (which necessitates more excitation).

It is now clear that if we generate the exciting current in the rotor, just as with a synchronous machine, this compensated asynchronous machine will be superior to the ordinary synchronous machine, on all points where the ordinary asynchronous machine is superior to the synchronous machine.

We are, therefore, able to select much more advantageous modes of construction than we could hitherto. Instead of the narrow machines of large diameter, we are able to adopt broad and better mechanical designs of smaller diameter with few slots per pole, using former-wound coils, without fearing excessive leakage. In general we may say that these modern machines will be smaller and easier to construct, giving a higher output for the same expenditure.

The advantages of a compounded and self-exciting asynchronous alternator may be enumerated as follows:—

1. No difficulties whatever in paralleling.
2. They give a steady voltage at the motors on a variable load, and, therefore, better enable us to supply lighting direct from the same bus-bars.
3. They are absolutely proof against variations in load, and no falling-out-of-step exists.
4. They are simpler and cheaper to construct, and the material is used more effectively.
5. When, also, compensated or compounded *motors* are used, they enable the cable system to be used with a far better efficiency.
6. No exciters are necessary.
7. They do not require a uniform turning-moment, as is essential with synchronous generators ($\frac{1}{100}$ is quite sufficient).

They are the ideal machines for power work in general, as they ensure a higher efficiency all round, safety and ease

in working, and the possibility, more than at present, of doing away with sub-stations, and, therefore, a general standard system of supply and distribution can be designed for all schemes, with the least possible capital outlay, and also an important reduction in working costs.

Construction.—(*a*) *Compensated Machines.*

If an ordinary induction machine is loaded, either as motor or as a generator, it takes from the mains a *constant* exciting current, which is ¼ period out of phase with the voltage of the mains (fig. 1A).

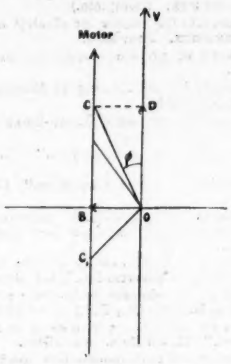

Fig. 1A.

Now it is possible to do away with this exciting current if we can produce the revolving field in the *rotor*, by bringing an exciting current to the rotor through brushes and a commutator.

This exciting current is generated in a few coils on the stator and in parallel with the rotor-winding (which is short-circuited).

It is clear that at any speed of the rotor, the revolving field rotates exactly synchronously with the stator field.

If the rotor did not revolve, we should have the same back E.M.F. and the same frequency as in the stator (the windings being equal), and the magnetising currents would represent the same energy as we had before in the stator of an ordinary induction motor.

But as the number of revolutions in an induction machine is always very near the synchronous speed (4 or 5 per cent.), the frequency of the rotor field is very low. At synchronous speed the field is constant, and at increasing load (and slip), the field frequency increases proportionally up to the maximum of 4 or 5 per cent. of the stator or supply frequency.

The duty of the commutator is therefore to transform alternating current of high frequency (stator) into low frequency of the rotor, producing in the rotor a field absolutely synchronous with the stator field and of a frequency proportional to the slip.

The first result is that this compensating current in the rotor requires only a small E.M.F., not much more than the ohmic drop, on account of the low frequency; it is therefore almost entirely a watt current of about 1 per cent. of the total capacity of the machine. In ordinary machines the magnetising current corresponds to an apparent capacity of about 30 per cent. of the total capacity. It is therefore possible either to take only a few coils of the stator winding to generate the compensating current, or to take it from the terminals through a small transformer.

The second result is that it is possible to strengthen the effect, as the compensating current absorbs but few watts. This means that it is possible to *compound* the machine not only against its own wattless current, but also against the outside wattless currents (caused by inductive load).

If we imagine, instead of the auxiliary winding, commutator and brushes, an ordinary two-pole field free on the shaft, supplied with continuous current, we have the same effect, since this field revolves synchronously with the stator-field.

This shows that the current supplied to the auxiliary winding has nothing to do with the actual work of the machine—in fact, it can be disconnected without interfering with the working. The commutator serves quite a different purpose than in an ordinary continuous-current machine, has none of the disadvantages, such as the many segments, sparking, &c., and is therefore no detriment at all. It is only a means for self-excitation, is very small, and works exactly as a slip-ring. It is connected directly or indirectly with the short-circuited winding of the rotor, and therefore there are no self-induction currents or disruption sparks. The number of segments need only be just enough to prevent short-circuit between two brushes (about four to six per pole).

As the internal wattless current is compensated for, there remain only watt currents, whether the machine be worked as a motor or as a generator, on non-inductive load. These watt currents (stator current and induced rotor current) are, of course, equal and in opposite directions, and therefore these machines do not possess any armature reaction (except that caused by leakage and ohmic drop), which in synchronous machines is a necessary evil. The full armature reaction, however, exists for wattless currents, and this, of course, is necessary for parallel working.

(*To be continued.*)

ELECTRIC TRAMWAY ACCOUNTS.

Some months ago we referred to the chaotic system at present prevailing in regard to tramway statistics, pointing out that nothing had been done to bring the figures relating to different undertakings into line. At the same time we drew attention to the model form of returns suggested by the Tramway and Light Railway Association, and submitted by that body to the Board of Trade. While criticising that form on particular points, we expressed our agreement not only with the broad principles laid down therein, but also with much of the detail, which had been elaborately worked out in its tables.

We have now had an opportunity of perusing a document which has been submitted to another important association connected with tramways. We refer to a report which has been submitted by Mr. James Dalrymple, of Glasgow, to the Municipal Tramways Association of Great Britain on the subject of "Standardisation of Tramway Accounts." As would be expected from the title, this deals with tramway statistics purely from the accountancy standpoint, and does not go so fully into the matter as the model form of returns mentioned above, which included a large number of headings relating to the engineering aspect of the industry. But as regards the subject with which this report professes to deal, we would say at once that it gives very full and precise information on all points in a clear and concise shape. We think, however, that a short critical description will best bring out the main points of interest.

The report begins with what may be called a preface giving the objects of the writer and stating the limits within which he confined himself in drawing up his statements. It was, in short, his desire to draft a model annual financial statement for the guidance of municipal tramway managers and borough accountants in stating their annual tramway accounts, and he adds that he has based his work on the form which has been adopted by the street railways of America with some assistance from the report on the uniform classification of working expenses presented at the meeting of the International Tramways Union, which was held in London about a year ago.

To come now to the body of the report. The first statement is the annual revenue account on the Dr. side, of which the expenditure is classified under the main heads of power expenses, traffic expenses, general expenses, repairs, permanent-way renewal, and depreciation, in no less than 46 distinct items. A column is provided showing the expenses per car-mile in each case, while as regards the power expenses an additional column is given for the KW.-hour expenses. In addition space is left for recording the corresponding figures of the previous year, so that it is possible to see at a glance how the expense incurred in respect of each separate item compares with that of the preceding twelve months. There is also room provided at the top of the form for the figures showing the kilowatt-hours and the car-mileage. It will thus be seen that the revenue account goes very fully into detail on the all-important subject of ex-

penditure, and little difficulty, if any, should be experienced by any person using this form in getting at the cause of any undue increase which might take place in his expenses.

It may be said, however, that it would be difficult to distinguish in regard to so many items, and that it would, therefore, be impossible to compare undertakings, even though they might use this form, as the respective accountants might differ as to the item to which any particular charge should be debited, especially as to repairs, renewals and depreciation. This trouble is met by a comprehensive appendix giving a very full classification of working expense accounts, showing in detail the charges included under each item; and we venture to think that, with this before them, all accountants would work on the same lines.

The second statement gives the net revenue account, on the debtor side of which is shown the interest on capital and the sinking funds. Here, too, columns are provided for the car-mileage expenses and for the corresponding figures of the previous year. We then come to the appropriation account, which shows the amount carried to the general reserve fund, and the final balance left for the relief of the rates or for any other appropriation.

These forms complete the accounts relating to the revenue, and there follows a statement giving the capital expenditure account for the year. This is followed by the capital account as at the conclusion of the year, which gives in pretty full detail the capital expenditure under the following main heads:—Permanent way, electrical equipment of line, ground, buildings and fixtures, power station and sub-station plant, workshop tools and sundry plant, cars, electrical equipment of cars, miscellaneous equipment, office furniture, Parliamentary expenses and preliminary expenses. As in the case of the revenue account, uniformity is secured by an appendix which gives at considerable length the charges to be made against each item. Further, a column is given for the figures of the previous year, and the necessary deductions for depreciation are shown.

The next statement is the balance-sheet, which is followed by a page giving various items of general information relating to the undertaking in a brief form. In this connection we would draw attention to the item "Mileage of Track," where we presume the total length refers to route mileage, though this is not made clear in the table. Other instructive items are Population served by Tramways, Car-Miles, Passengers Carried, Average Number of Cars in Use for —hour day, Percentage of Working Expenses (including and excluding depreciation) to Receipts, Average Car-Miles per Day per Car, and, most important of all, *Average Car-Hours per Day*. In addition, there is an instructive scale of fares and a very useful item showing the average journeys per head of population per annum.

In conclusion, we would say that we have nothing but praise for this very full and detailed report of tramway accounts. Though it is specifically intended for municipalities, it could be easily modified for application to company undertakings, and we consider that a merging of this form in the model form of returns drawn up by the Tramway and Light Railway Association would supply us with a general form of accounts and statistics eminently suitable for enabling fair comparison to be drawn between various undertakings. We feel, however, that a discussion of the form by experts would be of the greatest benefit to those interested in the industry. The report was fully discussed at last week's meeting of the Municipal Tramways Association of Great Britain. The meeting resolved that standardisation was most necessary, and it is proposed to join hands with the Borough Treasurers' Association in endeavouring to get a standard form agreed upon and adopted.

NEW PATENTS APPLIED FOR, 1903.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, to whom all inquiries should be addressed.

14,320 "Improvements in or relating to contract breakers for induction coils." H. W. van Raden and C. B. Robinson. June 29th.

14,476. "Improvements in or connected with arc lamps." J. L. Davies. June 29th.

14,500 "Improvements in overhead equipment for electric traction, applicable also for use with other exposed conductors." H. Smithson and E. R. Sharpe. June 30th.

14,520. "Improvements in switches." J. L. Albiez, Jun. June 30th. (Complete.)

14,523. "The ship's telegraph alarum." P. Manson. June 30th. (Complete.)

14,537. "A new or improved electrically lighted club for theatrical and like displays." T. H. Davies and G. B. Davies. June 30th.

14,538 "An eccentric combined lever grip and controller." C. Francis and E. Levene. June 30th.

14,539. "Improvements in armature coils for dynamo-electric machines." The British Westinghouse Electric and Manufacturing Co., Ltd. (The Westinghouse Electric and Manufacturing Co., United States.) June 30th.

14,541. "Improvements in galvanic dry cells." G. Schauli and W. Loewenstein. June 30th.

14,542. "Improvements in controlling devices for electric motors." D. L. Lindquist. June 30th. (Complete.)

14,543. "Improvements in holders for telephone directory cards and the like." C. E. Napp. June 30th. (Complete.)

14,550. "Improvements in life guards for electric cars and other vehicles." J. F. Mason and H. Kremmitz. June 30th.

14,551. "Improvements in electric controllers for motors and the like." A. Sundh. June 30th.

14,558. "Improvements in and relating to electro-magnets." D. L. Lindquist. June 30th. (Complete.)

14,561. "Improvements in automatic circuit-breakers." H. P. Ball. June 30th. (Complete.)

14,562. "Improvements in circuit breakers." H. P. Ball. June 30th. (Complete.)

14,563. "Improvements in electric switches." H. P. Ball. June 30th. (Complete.)

14,566. "Improvements in means for electrically-driving centrifugal engines." H. J. Haddan. (The American Tool and Machinery Co., U.S.) June 30th. (Complete.)

14,597. "Improvements in machines for making bases for electric lamps." E. A. Carolan. (The General Electric Co., U.S.) June 30th.

14,598. "Improvement in electric motor-driven machine tools." E. A. Carolan. (The General Electric Co., U.S.) June 30th.

14,601. "Improvements in coin mechanism specially applicable for electricity and other meters." E. Du Bois. June 30th.

14,602. "Improvements in coin mechanism specially applicable for electricity and other meters." E. Du Bois. June 30th.

14,610. "A dynamo-electric generator for the production of high voltage continuous currents without commutation." F. Hamer. June 30th.

14,654. "Mode of, and apparatus for, converting the energy of fuel into electric energy." H. Jone. July 1st.

14,656. "Mode of, and apparatus for, heating voltaic cells and restoring the battery products thereof to the original state." H. Jone. July 1st.

14,671. "Improvements in electrical shot-firing or like apparatus." R. C. W. Wood and G. Clifton. July 1st.

14,697. "Improved manufacture of frames for dynamo-electric machines." Siemens Bros. & Co., Ltd. (Siemens & Halske Aktien Gesellschaft.) July 1st.

14,721. "Improvements in and appertaining to holders for electric incandescent lamps." C. H. Jones. July 2nd.

14,781. "Improvements in electrolytic separation of copper and nickel." P. R. J. Willis. (C. S. Shields, Canada.) July 2nd.

14,770. "Improvements in electric motors or dynamos." W. E. Burnand. July 2nd.

14,814. "Improvements in or connected with electrical resistances or rheostats applicable as a regulator, motor starting switch, or the like." S. G. Brounger and W. G. Haywood. July 3rd.

14,908. "Improvements in or relating to electric contacts." E. E. Prestwich and E. C. Lea. July 4th.

PUBLISHED SPECIFICATIONS, 1902.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson and Co., 322, High Holborn, W.C., and at Liverpool, price, post free, 9d. (in stamps).

4,032. "Improvements in and relating to electrical distributing systems." L. Andrews. Dated February 17th.

4,763. "Improvements in arc lamps." W. Crudgington. Dated February 29th.

4,793. "Improvements in intercommunication telephone systems." T. Sloper and I. H. Parsons. Dated February 25th.

4,999. "Improvements in electric igniting plugs for internal combustion engines." F. H. Hadfield. Dated February 27th.

5,010. "Improvements in electric meters." A. Blanchet. Dated February 27th.

5,032. "An improved electric pole changer for use in railway signalling and the like." J. P. O'Donnell and E. C. Irving. Dated February 27th.

5,260. "Improved apparatus for preparing flattened metallic coils for electrical magnets, solenoids, and other purposes." R. E. B. Crompton. Dated March 30th.

5,294. "Electric rammer for foundry and other use." D. A. Caspar. Dated March 3rd.

5,412. "Improvements in or connected with electric meters." L. Leclerc. Dated March 4th.

5,538. "Improvements in apparatus for the electro-deposition of metals." The Calico Printers' Association and W. Cotsworth. Dated March 6th.

6,034. "Improvements in or relating to electric arc lamps." C. Oliver. Dated March 11th.

6,122. "Improvements in electrical switches or circuit closers and breakers." Otis Elevator Co., Ltd. (Communicated U.S.A.) Dated March 12th.

6,345. "Improvements in electric light signals." W. Taboulewitsch. Dated March 14th.

6,947. "Improvements in connections for electric cables." Callender's Cable and Construction Co., Ltd., and H. Hastings. Dated March 21st.

7,039. "Improvements in electric fuses." S. Z. de Ferranti. Dated March 22nd.

7,075. "An improved electrical measuring instrument." W. M. Thornton. Dated April 23rd.

7,420. "Improvements in and relating to electrical switches." G. Sperryn. Dated March 27th.

7,478. "Improvements in galvanic batteries." P. Decafore. Dated March 27th.

8,136. "Improvements in connection with fittings for the overhead trolley wires of electric tramcars." G. Hill. Dated April 8th.

8,857. "Improvements in electric motor control systems." The British Thomson-Houston Co., Ltd. Dated April 12th.

10,098. "Improvements in starting switches for electric motors." T. E. Weaver. Dated May 2nd.

10,144. "Improved fuse holder for electric current." J. J. Rawlings and W. R. Rawlings. Dated May 2nd.